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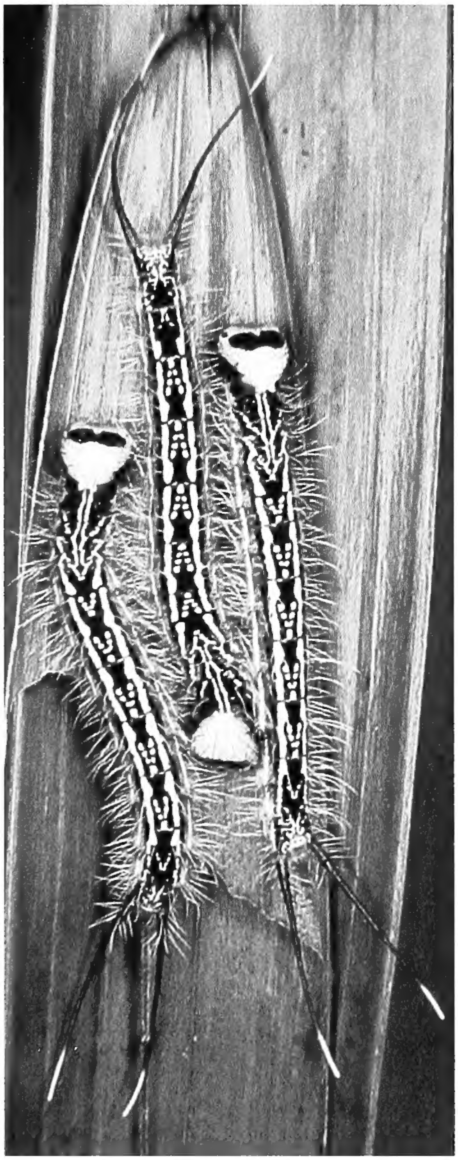

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Cover illustration: Fourth instar larvae of *Antirrhea weymeri* Salazar, Constantino & Lopez, Colombia. See vol. 58(2): pp. 88-93. Photo by Maria Dolores Heredia

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A NEW SPECIES OF *CARISTANIUS* HEINRICH (LEPIDOPTERA : PYRALIDAE : PHYCITINAE) FROM SOUTHERN MEXICO

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Heinrich (1956), in his revision of the American Phycitinae, proposed the genus *Caristanius* to accommodate *decoloralis* described by Walker in 1863 and *pellucidella* and *guatemalella* described by Ragonot (1888a, 1888b). I added two species, *minimus* and *tripartitus*, in 1977 and 1996, respectively. The genus is entirely New World with representatives mainly in the Neotropics, but with elements in some of the warmer parts of the Nearctic Region.

In 1986 I reported the presence of *Caristanius decoloralis* near Veracruz, Estado de Veracruz, Mexico. Recent additional study by me of the five males and two females on which this record was based has shown that the specimens, although quite similar to *C. decoloralis*, represent an undescribed species. A description of this new species, as well as a key including it and other known members of the genus, are presented here.

CARISTANIUS VERACRUZENSIS, NEW SPECIES
(FIGS. 1-4)

Diagnosis. - *Caristanius veracruzensis* has a small, short, fingerlike, only slightly curved, subcostal process on the valva (Fig. 2).

Description. - Forewing length 9.0 - 10.0 mm. Head: vertex pale brown to brown dusted with white; labial palpus pale brown to brown dusted with white and extending obliquely to above vertex in both sexes, robustly scaled and in contact with vertex in male; maxillary palpus ochre, mostly long-scaled in male, pale brown to brown dusted with white, short-scaled in female; antenna of male with sinus and well developed, brown, dusted with white, tuft of scales at base of shaft and with sensilla trichodea (cilia) of shaft abundant and about 1/7 as long as width of shaft just distad of sinus; antenna of female simple. Thorax: dorsum pale brown to brown lightly dusted with white (some specimens with ochre or pale reddish brown scales). Forewing: mostly brown dusted with white; antemedial line very weakly formed, only visible on some specimens on posterior half of wing; brownish red patch shaded by varying amounts of black basad of antemedial line; postmedial line absent or very faint; discal spots dark brown. Hindwing: above chiefly white,

FIG. 1. *Caristanius veracruzensis*, male (holotype).

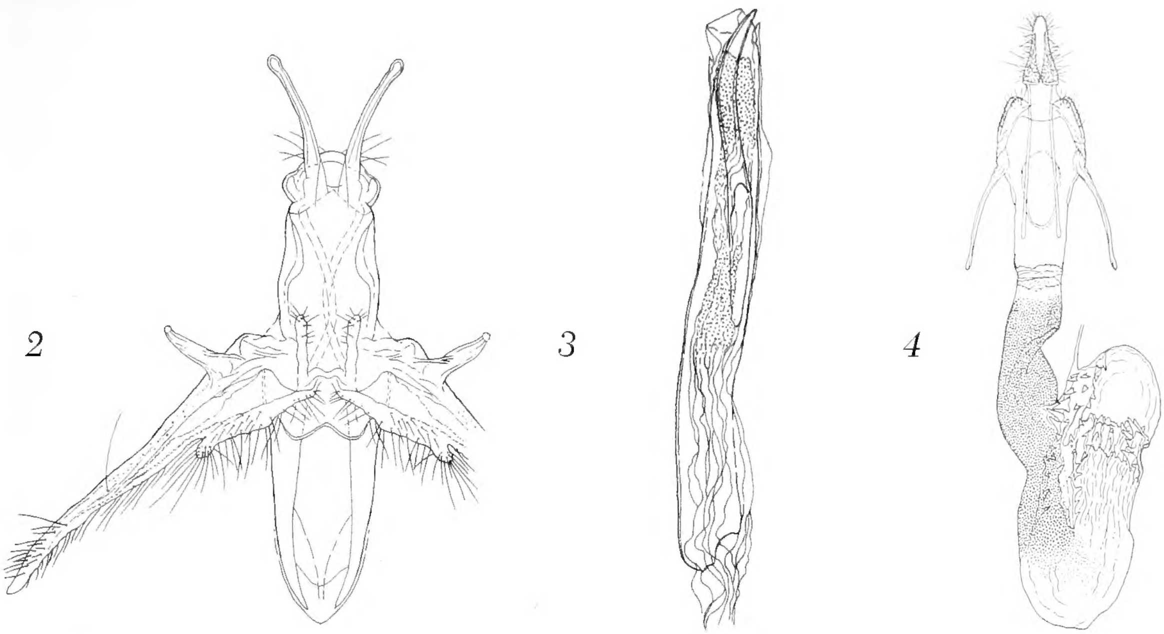
some brown along anterior margin. Male genitalia (Figs. 2, 3): uncus short, broader than long with pair of sclerotized, glabrous, divergent arms arising basally from ventrolateral angles; gnathos absent; transtilla absent; juxta a narrow, M-shaped band with long, slender setiferous, lateral arms; valva slender (particularly in distal 2/3) with short, fingerlike, slightly curved, subcostal process; sacculus with short, blunt, setiferous distal projection; aedoeagus slender; vesica with strongly formed, slightly hooked, cornutus (cornutus about 1/2 as long as aedoeagus); vinculum longer than greatest width. Female genitalia (Fig. 4): ostium bursae broad, strongly sclerotized; ductus bursae flattened, sclerotized, except near distal extremities of apophysis anterioris, and with many scobinations toward corpus bursae; corpus bursae elongate, scobinate near junction with ductus bursae, and with two longitudinal plates and one transverse plate; plates fused together in posterior half of corpus bursae and bearing large spines; corpus bursae indented where transverse plate extends to lateral margin of corpus bursae; ductus seminalis attached to corpus bursae near junction of ductus bursae and corpus bursae.

Holotype: ♂. 5 km. S. of Veracruz, Estado de Veracruz, Mexico, 23-VII-1984, H. H. and K. M. Neunzig, genitalia slide 987 HHN [USMN].

Paratypes: 4 ♂, 2 ♀. Same collection data, genitalia slide 988 HHN [NCSU].

Etymology. - The specific epithet is based on the type locality (Veracruz).

Remarks. - The male and female genitalia of



FIGS. 2-4. *Caristanius veracruzensis*: 2, male genitalia (aedoeagus omitted). 3, aedoeagus. 4, female genitalia.

KEY TO SPECIES OF MALE *CARISTANIUS*

1.	Uncus with broad, multiridged collar surrounding a slender, setiferous, posteriorly directed protuberance (Neunzig and Dow 1993, Fig. 273)	*guatemalellus* (Ragonot)
—	Uncus with pair of glabrous arms arising basally from its ventrolateral angles	2
2.	Subcostal process of valva with distal part folded and contorted (Heinrich 1956, Fig. 297)	*pellucidellus* (Ragonot)
—	Subcostal process of valva not folded and contorted distally	3
3.	Occurs in southeastern United States	4
—	Occurs in Neotropics	5
4.	Cornutus of vesica about as long as aedoeagus (Neunzig 1977, Fig. 4)	*minimus* Neunzig
—	Cornutus of vesica as long as aedoeagus (Heinrich 1956, Fig. 298a; Neunzig 2003 text Fig.94b)	*decoloralis* (Walker)
5.	Subcostal process of valva long, about as long as valva (Neunzig 1996, Fig. 59). Distribution: Dominican Republic	*tripartitus* Neunzig
—	Subcostal process of valva short, about 1/5 to 1/4 as long as valva (Fig. 2). Distribution: southern Mexico	*veracruzensis* n.sp.

Caristanius veracruzensis are most similar to those of *Caristanius decoloralis*. In *C. veracruzensis* the subcostal process of the valva is essentially straight with only a slight curve distally, the cornutus of the vesica is about 1/2 x as long as the aedoeagus, and the corpus bursae is significantly indented and strongly spined laterally. In *C. decoloralis* the subcostal process of the valva is sinuate throughout its length, the cornutus of the vesica is as long as the length of the aedoeagus, and the corpus bursae is not significantly indented and not strongly spined laterally.

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RELATIONSHIPS AMONG POPULATION ESTIMATION TECHNIQUES: AN EXAMINATION FOR *PARNASSIUS SMINTHEUS* DOUBLEDAY (PAPILIONIDAE)

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Estimating the abundance of organisms is an important aspect of ecology. In fact, if we adhere to Krebs' (1972) definition of ecology as "the scientific study of the interactions that determine the distribution and abundance of organisms" it is fundamental to the field. Estimates of population size form the basis for ecological and conservation studies. A multitude of methodologies exist to estimate population abundance. These methods differ in their suitability for species, the assumptions involved, the accuracy of the estimates, and the effort and cost needed to perform. The most appropriate technique will likely depend on the objectives of the study and a balance between the precision and parameters needed and the cost and effort of each method. Because of differences in methodology, estimates of abundance may not be directly comparable among studies. Here, we examine the relationships among several common population estimation techniques used for butterflies.

Butterflies are popular study organisms for a variety of ecological and evolutionary questions and many species are often used as indicators in conservation studies (Blair 1999, Brown and Freitas 2000). It is our hope that this study will allow more meaningful comparisons of population data collected using different methods and provide guidance in selecting among common techniques.

Materials and Methods

Study species and site. The butterfly *Parnassius smintheus* Doubleday (Papilionidae) is abundant within subalpine meadows in the Rocky Mountains, although congeners are threatened elsewhere (Kuras et al. 2000). The butterflies' host plant, *Sedum lanceolatum* Torr. (Crassulaceae), occurs in gravelly sites above tree-line (Fownes and Roland 2002). *Parnassius smintheus* is univoltine with a flight period from mid July to September in our study area. Adults nectar on yellow flowered species such as *S. lanceolatum*, *Solidago multiradiata* (Asteracae), and *Senecio lugens* (Asteracae) (Matter and Roland 2002).

Transect surveys and mark-recapture of *P. smintheus* were conducted in nine meadows within a network of 21 meadows located along Jumpingpound Ridge, Alberta, Canada (51° 57'N, 114° 54'W). Each meadow was considered as containing a 'population.' Meadows are comprised of grasses, sedges, and wildflowers, and are bordered on their lower slopes by forest consisting of *Pinus contorta*, *Abies lasiocarpa*, and *Picea engelmannii*.

Population estimation methods. For transect surveys, each observer walked a path through the middle (along the longest axis) and around the circumference of a meadow tallying the number of *P. smintheus* observed at any distance in front of them. As *P. smintheus* fly more frequently when it is sunny (Ross et al., in press), observations were conducted during full sun. As a rubric, we stopped walking and counting if we could no longer see our shadow. For each survey there were between two and four observers. Transect surveys were conducted prior to mark-recapture, on the same date, to provide comparisons.

For mark-recapture estimates, we captured butterflies using hand nets and each newly captured butterfly was given a unique 3-letter code on the upper surface of each hind wing using a felt-tipped pen. For all captures, we recorded the date, time, location, and identity mark (Roland et al. 2000, Matter and Roland 2002). To equilibrate effort among populations, recapture continued until ~75% of recaptured butterflies had been previously captured that day. Populations were sampled from 3-7 times between July 27 and August 20, 2001.

Transect surveys. Transect surveys are perhaps the simplest population estimation technique. This method assumes, if multiple observers or observations are involved, a consistent path or amount of time is

used, and that observers have similar ability in identification (Pollard 1977, Thomas 1983). To arrive at a population estimate for transect surveys, we calculated the mean and variance of the number of butterflies reported by the observers.

Number of individuals captured. This was the simplest mark-recapture technique. For this estimate we tallied the total number of different individuals caught during a sampling session. This and all other methods involving marked individuals (below) assume that marks are not lost, and that marking and handling do not affect behavior, survival, or the probability of capture.

Craig's Method. Craig's method is a slightly more complicated mark-recapture technique based on the frequency of capture during a single sampling session (Craig 1953, see also Southwood 1994). Thus, it uses some data often discarded by other methods, and may not be applicable for small mammals or other organisms which are usually caught only once per session or with unequal capture probability (Edwards and Eberhardt 1967, Nixon et al. 1967). Population estimation assumes that the frequency of butterflies captured once, twice, thrice, etc. follows a Poisson distribution. The number of butterflies not caught, the zero term of the distribution, is estimated and 'added' to the number of individuals caught to arrive at an estimate of population size. This method incorporates all the assumptions of marking and further assumes that all individuals in the population are at equal risk of capture at all times, i.e. there is instantaneous re-mixing upon release and no handling or marking effects that would effect capture. Craig's method also assumes that the population is closed, that is there is no birth, death, or migration during sampling. Population size was estimated using the equation:

$$\ln \hat{N} - \ln(\hat{N} - r) = s / \hat{N}$$

where $\hat{N}$ is estimated population size, r is the number of individuals captured, and s is the total number of captures (Craig's method 1, Craig 1953). We solved the equation above using the fsolve routine of Maple V. Variance of the estimate was calculated as:

$$\sigma^2_{\hat{N}} = \frac{\hat{N}}{e^{\lambda} - 1 - \lambda},$$

where $\lambda = s/\hat{N}$ (Southwood 1994). Capture probability can be estimated as $\hat{p} = r/\hat{N}$. Given $\hat{N}$ and λ, the expected number of individuals caught x times can be calculated from the Poisson equation:

$$E(\int_x) = \hat{N}e^{-\lambda}\frac{\lambda^x}{x!}.$$

Goodness of fit was evaluated by comparing these expected values to the observed values, where (observed - expected)^2/expected follows a χ^2-distribution. Evaluation can be made for each class of number of captures with one degree of freedom, or overall, by summing capture classes with degrees of freedom equal to the number of summands.

Geometric Model. Similar to Craig's method, the geometric model is also based on the frequency of capture and assumes a closed population. However the assumption of equal capture probability is modified and the model treats the number of times that an individual is captured as a geometric distribution. Population size was estimated using the equation:

$$\hat{N} = \frac{r(s-1)}{s-r},$$

and variance of the estimate as:

$$\hat{N}\hat{g} / \hat{q}^2,$$

where $\hat{q}$ = (s-r)/(s-1) and $\hat{g}$ = 1- $\hat{q}$ (Pollard 1977). Note that $\hat{g}$ is used rather than the traditional $\hat{p}$ to avoid confusion with capture probability. Capture probability can be estimated as $\hat{p} = r/\hat{N}$. Given $\hat{N}$, $\hat{q}$ and $\hat{g}$, the expected number of butterflies caught x times can be calculated as:

$$E(\int_x) = \hat{N}\hat{g}\hat{p}^x.$$

Goodness of fit can be evaluated using the same methods as for Craig's method (previous section).

Lincoln-Petersen. As opposed to the previous methods, the Lincoln-Petersen method requires captures on multiple occasions, in our case consecutive days. This method is based on the assumption that the ratio of marked individuals to the total population size will equal the proportion of marked individuals in a second sample. It assumes the assumptions for marked individuals, that populations are closed during and between sampling periods, and a constant capture probability. The equation:

$$\hat{N} = \frac{mn}{r}$$

was used to estimate population size, where m is the number of individuals marked on the first occasion, r is the number of recaptures, and n is the total number of individuals captured on the second occasion. For samples under 20, we used a small sample approximation (Baily 1952):

$$\hat{N} = \frac{m(n+1)}{r+1}$$

Variance of the estimate was calculated as:

$$\sigma^2_{\hat{N}} = \frac{m^2 n(n-r)}{r^3}$$

and as:

$$\sigma^2_{\hat{N}} = \frac{m^2(n+1)(n-r)}{(r+1)^2(r+2)}$$

for the small sample approximation (Southwood 1994). Estimated capture probability during the recapture period for the can be calculated as $\hat{p}$ = r/m (Skalski and Robson 1992).

Jolly-Seber. The Jolly-Seber method is similar to Lincoln-Petersen, but requires capture on three or more occasions. Importantly, this method relaxes the assumption of a closed population. Animals may enter the population via immigration or birth and leave the population via emigration or death. Without additional information, estimates can only be made for the combined effects of each, that is, total gain and loss to the population. The model is stochastic assuming that there is a probability that organisms will survive (not die or emigrate) from each census period to the next and that capture probability may also vary. Survival (ϕ), capture probability ($\hat{p}$), and population size ($\hat{N}$) were estimated using the program Jolly. We assumed fully parameterized models (time varying capture and survival probabilities) unless simpler models with constant survival, constant capture probability, or both constant did not significantly differ from the full model.

Analysis. We used linear regression to build predictive relationships between the population estimation methods. We constructed a separate model for each pair of methods. Because of non-linearity between some estimates, data were $\log_e$ transformed prior to analysis. Standard diagnostic techniques for regression were used including inspection of residuals and outliers. Not all population estimation techniques could be used for each sample date, e.g. sampling needed to be conducted on consecutive days for Lincoln-Petersen estimates. Thus, sample size varies among the techniques. We considered each population estimate to be an independent observation. It should be noted that some relationships involve cases where the dependent and independent variables are calculated using the same data (e.g. Lincoln-Petersen and Jolly-Seber both incorporate captures in the estimate of population size). In such cases correlations will be greater than expected by chance, affecting statistical inference; however, the regression equations describing the relationships are still valid.

Estimates for a population of known size. To estimate the accuracy of the techniques, we released a known number of male butterflies (24) into a meadow at lower altitude where they had never been observed and their host plant does not occur, but many of their nectar flowers do occur. Butterflies were released onto a nectar source at varying positions throughout the meadow. Sampling began 30 min after release. Butterflies were marked and recaptured as in the population surveys. Three observers who did not know the number of butterflies released, conducted the transect surveys and mark-recapture. We conducted one transect survey and two mark-recapture sessions separated by one hour for this population. We computed population estimates as for the natural populations. As there were only two capture sessions Jolly-Seber estimates could not be calculated.

RESULTS

There were significant, positive correlations among all the population estimation techniques (Table 1, Fig.1). Transect surveys produced the lowest estimates, while the geometric distribution provided the highest estimates of population size. Models for which a test could be preformed showed no lack of fit except for Craig's method for meadow Z.

For the population of known size (24 butterflies), the mean of the three observers' transect counts was 7.3 ± 5.3 (Var.). There were 16 and 14 captures for the first and second census, respectively. Craig's estimate for the first census was 24.4 ± 28.9 and 26.3 ± 69.5 for the second. The estimates from the geometric distribution were 40.0 ± 150.0 and 44.3 ± 304.2. The Lincoln-Petersen index estimated population size as 18.5 ± 3.5 butterflies.

DISCUSSION

The significant, positive relationships among the population estimation techniques were reassuring. Our limited investigation of the accuracy of the techniques shows that transect counts and the number of captures underestimate the actual population size. Craig's estimates were accurate while the Lincoln-Petersen estimate was lower than the actual population size, but provided a reasonable estimate. The geometric model overestimated population size. This experiment also allowed us to test our model and illustrate its utility and limitations. Note that the prediction of a single value of Y and its error for a given X in regression (prediction interval) differs from, and is greater than the distribution of Y (confidence interval) at a particular X (Zar 1999, p. 341). As an example, our transect count of

TABLE 1. Estimates of population size and associated parameters for *P. smintheus* in nine meadows along Jumpingpound Ridge. For Jolly-Seber mean values across all time periods are shown in italics if a point estimate for a particular census could not be calculated. If a model with constant capture probability or survival was uesd, mean values will be the same for all censuses and in roman text. Significant lack of fit is shown in bold. Goodness of fit is presented for the overall model for Jolly-Serber.

Meadow	Date	Transect		Captures	Craig's				Geometric				Lincoln-Petersen			Jolly-Seber				
		$\hat{N}$	$\sigma^2_{\hat{N}}$	N	$\hat{N}$	$\sigma^2_{\hat{N}}$	$\hat{p}$	χ^2	$\hat{N}$	$\sigma^2_{\hat{N}}$	$\hat{p}$	χ^2	$\hat{N}$	$\sigma^2_{\hat{N}}$	$\hat{p}$	$\hat{N}$	$\sigma^2_{\hat{N}}$	$\hat{p}$	$\hat{\phi}$	χ^2
F	8/6/01	53.5	60.5	37	88.0	466.4	0.42	0.39	158.1	2210.0	0.23	1.21	125.2	402.0	0.30	37.0	N/A	*0.42*	*0.81*	N/A
F	8/20/01	6.3	12.3	9	26.5	259.7	0.34	0.15	45.0	900.0	0.20	0.22	N/A	N/A	N/A	N/A	N/A	*0.42*	*0.81*	
G	8/6/01	66.0	882.0	75	753.6	130598.9	0.10	0.02	1462.5	527596.9	0.05	0.11	263.9	701.4	0.30	156.5	182.5	0.92	0.30	2.47
G	8/20/01	14.0	7.0	25	173.1	13484.5	0.15	0.02	325.0	50700.0	0.08	0.04	N/A	N/A	N/A	79.0	N/A	*0.66*	*0.81*	
g	8/6/01	76.5	264.5	35	329.8	50030.6	0.11	0.01	630.0	192780.0	0.06	0.19	154.2	471.3	0.25	39.0	N/A	*0.61*	*0.70*	0.01
g	8/20/01	7.0	1.0	17	28.3	48.1	0.60	0.22	47.2	233.2	0.36	0.62	N/A	N/A	N/A	N/A	N/A	*0.61*	*0.70*	
N	7/27/01	3.5	1.7	5	5.7	1.1	0.89	2.80	7.9	7.1	0.63	3.90	6.0	1.0	0.80	8.4	3.6	0.62	0.93	N/A
N	8/10/01	4.5	9.0	5	6.3	2.5	0.80	9.12	9.0	13.0	0.55	11.0	10.8	3.2	0.44	8.5	3.5	0.62	0.93	
N	8/20/01	3.0	0.0	2	3.4	6.5	0.58	0.41	4.0	8.0	0.50	0.50	N/A	N/A	N/A	3.2	2.7	0.62	0.93	
O	7/27/01	24.0	88.0	45	82.6	206.5	0.55	0.55	144.0	1013.8	0.31	2.33	65.5	71.7	0.70	46.0	N/A	0.67	0.91	3.77
O	8/10/01	36.0	123.3	87	110.5	44.2	0.79	12.89	176.1	364.8	0.49	4.08	196.8	579.4	0.45	271.1	N/A	0.67	0.94	
O	8/20/01	18.0	98.0	31	69.7	341.5	0.45	4.69	124.0	1488.0	0.25	2.81	N/A	N/A	N/A	N/A	N/A	0.67	0.94	
R	8/2/01	1.3	0.9	3	6.6	29.0	0.46	0.18	9.0	54.0	0.33	0.18	10.0	16.7	0.20	5.0	N/A	*0.67*	0.20	N/A
R	8/16/01	6.0	0.0	14	24.0	45.6	0.58	0.43	40.0	212.3	0.35	1.18	42.0	147.0	0.43	14.0	N/A	*0.67*	*0.62*	
S	8/2/01	12.0	38.7	18	27.8	38.9	0.65	0.74	45.8	180.2	0.39	1.29	36.0	54.0	0.56	88.6	24.5	0.84	0.65	0.02
S	8/16/01	2.7	0.3	16	25.8	41.3	0.62	1.63	42.7	189.6	0.38	3.33	43.2	181.4	0.22	32.0	N/A	*0.92*	*0.77*	
Y	8/14/01	4.3	4.3	14	18.6	11.2	0.75	5.32	29.2	65.8	0.48	3.36	23.3	31.1	0.36	14.0	N/A	1.00	0.83	N/A
Z	8/14/01	93.3	212.3	156	252.3	378.5	0.62	**11.83**	433.9	2150.5	0.36	7.96	309.7	700.1	0.44	179.3	1040.1	0.78	0.82	3.38

7.3 results in predictions of 26.0 ± 4.6 (95% P.I.) for Craig's estimate, 12.9 ± 3.5 for the number of captures, and 32.5 ± 3.9 for the Lincoln-Petersen estimate. The actual estimates fall within the prediction intervals for Craig's estimate and the number of captures, but not for the Lincoln-Petersen method. This demonstration illustrates both the utility of our model and its difficulties. For small population sizes it may be difficult to obtain a precise estimate. This problem can especially be seen by the fact that the intercepts of some relationships were significantly different from zero (Table 2). For example, a transect count of zero may indeed indicate the presence of no butterflies, but could result in an estimate of 6.6 based on the Lincoln-Petersen estimate.

Although the equations presented here apply only to *P. smintheus* at our study site, the results do illustrate the relative strengths and weaknesses of the various techniques. Given the varying reasons for estimating population abundance, a variety of methods have been and will continue to be used. For butterflies, transect surveys are perhaps the easiest and least disruptive method of population estimation requiring only the ability to identify species on the wing. For some groups or assemblages this may be quite difficult, necessitating either netting or grouping of species that cannot be distinguished. For conspicuous, easily identifiable, species transect surveys are an efficient means to generate relative estimates provided observability (capture probability in mark-recapture terminology) does not vary. However, transect surveys do not provide accurate estimates of population size, nor do they allow for estimation of observability which limits their utility for comparison. Transect surveys, as conducted here under highly favorable conditions, result in large underestimates of population size. This underestimation is especially important in determining presence or absence. A transect survey producing no butterflies does not mean that the species is absent. Accurate determination of local absence or extinction always will require additional, intensive sampling.

All other methods investigated here require both the capture and marking of individuals which may alter behavior (Mallet 1987). In general, capture temporarily reduces the propensity of butterflies to fly. Reduced flight in turn lowers the capture probability of marked individuals relative to unmarked individuals for the length of time that the butterflies are affected (Gall 1985). Frequency of capture methods (Craig's and geometric) will be more influenced by a temporary change in behavior than other methods. If marked individuals temporarily have a lower capture probability than unmarked individuals, estimates of population size will be higher than the actual population size (Gall 1985). For other mark-recapture methods, any temporary handling effect usually will have abated by the next census period. For *P. smintheus* the effects of marking on flight are minimal; however capture probability is lower for females than for males violating the assumption of equal capture probability for Craig's and the Lincoln-Petersen methods (Roland et al. 2000, Matter and Roland 2002). We note that our estimates for a population of known size used only males, and thus should not violate this assumption; however, this bias will affect estimates for the populations along Jumpingpound Ridge.

The number of individuals captured underestimates population size as the capture rate rarely nears 100 percent. However, assuming marks are not lost, the number of individuals captured does provide an estimate of the minimum possible population size. For the effort of tallying the number of times each individual butterfly is captured, Craig's method provides fairly accurate estimates of population size at a specific time, while the geometric distribution overestimated population size. Interestingly, both frequency of capture methods showed good fits to the data despite assuming different distributions for capture frequency. In general, fits were better for Craig's method than for the geometric distribution. This result contrasts with Pollard (1977) who found better fits for the geometric distribution than for the Poisson distribution of Craig's method in his investigation of three butterfly species. Our result is all the more surprising given that the geometric distribution should better accommodate the difference in capture probability between males and females than should the Poisson distribution.

The Lincoln-Petersen method requires capture on two or more, and Jolly-Seber on three or more occasions. Both provide good population estimates provided assumptions are met (Southwood 1994). In our study, it is unlikely that we meet either the assumptions of a closed population or equal capture probability required by the Lincoln-Peterson method. For the Lincoln Peterson method, the loss and gain of individuals after the initial marking period will result in overestimation of population size (Gall 1985). Jolly-Seber has the advantage of providing parameters for capture, survival, and recruitment, but requires more sampling occasions.

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TABLE 2. The relationship among population estimation methods. The dependent variable is in columns and the independent variable is in rows. The regression equation (SE) is on top and statistics for the relationship in the bottom of each cell. All relationships were significant ($P < 0.001$). A °° indicates that the intercept differs significantly from 0 ($P < 0.05$).

	Transect	Craig's	Geometric	Number of captures	Lincoln-Petersen	Jolly-Seber
Transect		1.17±0.36** 1.05±0.13 R^2=0.80 $F_{1,16}$=64.2	1.48±0.40 1.12±1.45 R^2=0.79 $F_{1,16}$=59.7	0.97±0.29** 0.80±0.11 R^2=0.78 $F_{1,16}$=57.3	1.89±0.34** 0.80±0.12 R^2=0.81 $F_{1,11}$=46.41	1.54±0.46** 0.77±0.16 R^2=0.64 $F_{1,13}$=22.7
Craig's	-0.41±0.32 0.77±0.10 R^2=0.80 $F_{1,16}$=64.2		0.20±0.04** 1.08±0.01 R^2=0.99 $F_{1,16}$=1093.2	0.31±0.33 0.70±0.08 R^2=0.82 $F_{1,16}$=73.5	0.95±0.30** 0.79±0.07 R^2=0.91 $F_{1,11}$=113.5	0.83±0.48 0.70±0.12 R^2=0.73 $F_{1,13}$=35.2
Geometric		-0.18±0.40** 0.93±0.01 R^2=0.99 $F_{1,16}$=1093.2		0.19±0.34 0.65±0.08 R^2=0.82 $F_{1,16}$=72.0	0.78±0.32** 0.74±0.07 R^2=0.91 $F_{1,11}$=112.3	0.72±0.50 0.65±0.11 R^2=0.73 $F_{1,13}$=34.6
Number of captures	-0.41±0.41 0.98±0.13 R^2=0.78 $F_{1,16}$=57.3	0.30±0.43 1.17±0.14 R^2=0.82 $F_{1,16}$=73.5	0.53±0.47 1.26±0.15 R^2=0.82 $F_{1,16}$=72.0		0.74±0.31 1.04±0.10 R^2=0.92 $F_{1,11}$=118.7	0.52±0.34 1.00±0.11 R^2=0.87 $F_{1,13}$=85.8
Lincoln-Petersen	-1.42±0.62** 1.01±0.15 R^2=0.81 $F_{1,11}$=46.4	-0.77±0.45 1.16±0.11 R^2=0.91 $F_{1,11}$=113.5	-0.58±0.48 1.24±0.12 R^2=0.91 $F_{1,11}$=112.3	-0.39±0.33 0.88±0.08 R^2=0.92 $F_{1,11}$=118.7		0.16±0.60 0.86±0.14 R^2=0.76 $F_{1,11}$=35.5
Jolly-Seber	-0.37±0.64 0.83±0.17 R^2=0.64 $F_{1,13}$=22.7	0.14±0.65 1.05±0.18 R^2=0.73 $F_{1,13}$=35.2	0.34±0.70 1.13±0.19 R^2=0.73 $F_{1,13}$=34.6	-0.07±0.34 0.87±0.09 R^2=0.87 $F_{1,13}$=85.8	0.80±0.56 0.89±0.15 R^2=0.76 $F_{1,11}$=35.5	

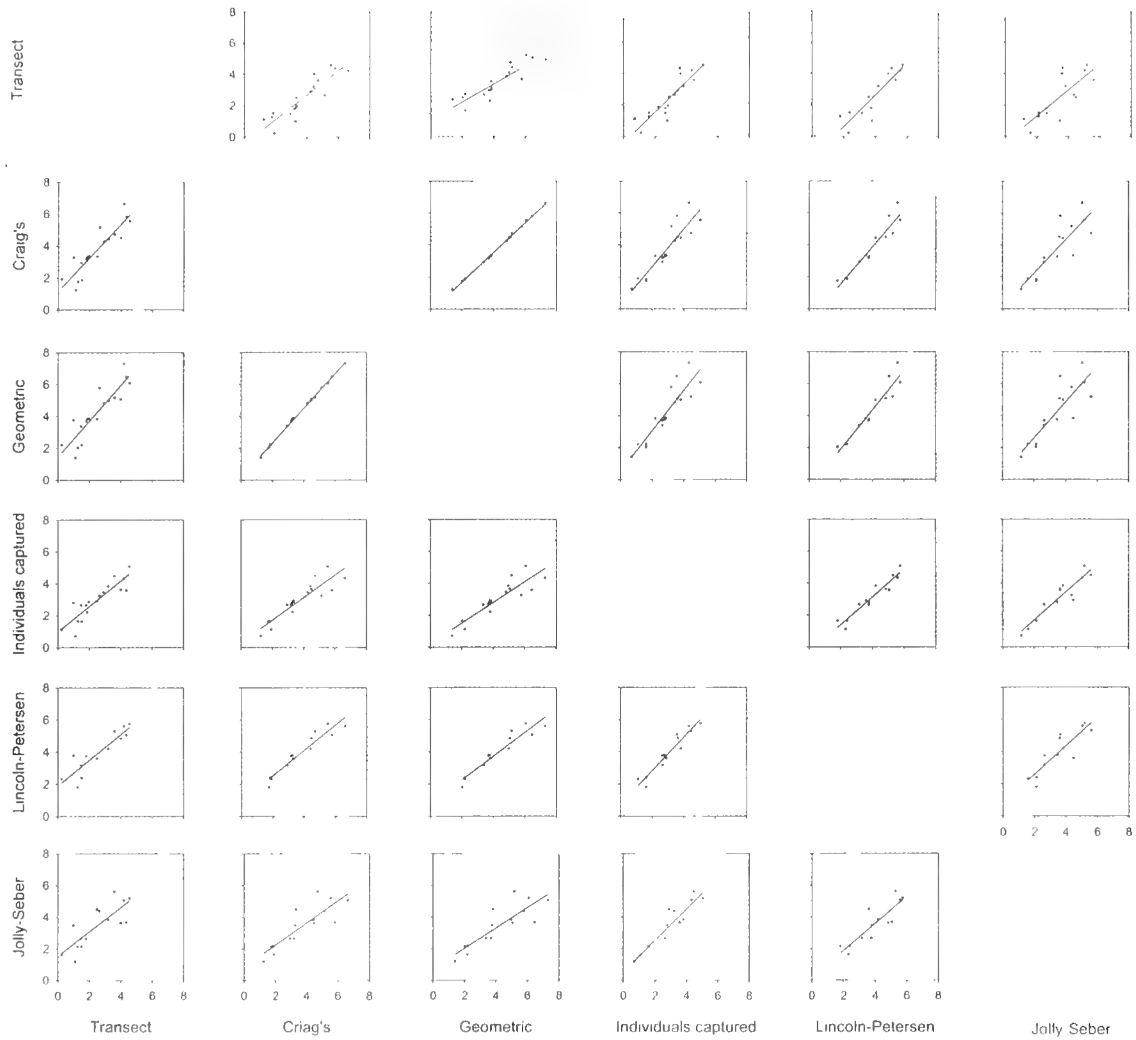

FIG. 1. Relationships among population estimation methods. Population sizes of the butterfly *Parnssisus smintheus* were estimated from 3-7 times in nine meadows using several population estimation techniques. The realtionship between each pair of techniques was evaluated using linear regression. Data were log$_e$ transformed prior to analysis.

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MANUAL VERSUS AUTOMATIC MOTH SAMPLING AT EQUAL LIGHT SOURCES - A COMPARISON OF CATCHES FROM MT. KILIMANJARO

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ABSTRACT. Nocturnal moth ensembles are frequently assessed using either catches from automatic light traps or manually collected samples at artificial light sources. Up to now, few studies have compared the influence of these methodological differences on the samples. We compared such samples, attracted by identical light sources, using geometrid moths in the montane rainforest belt of Mt. Kilimanjaro, Tanzania, as an example. The average number of moths caught manually from 1900 h to 2200 h at a light tower - a reflective gauze cylinder with a lamp placed in the middle - was more than ten times higher than that caught in a light trap, with more than half of all species only recorded at the light tower. With regard to individuals sampled, catches were biased towards the subfamily Ennominae in the traps (51% versus 30%) and towards Larentiinae in the manual samples (68% versus 44%). It remains to be tested whether the relatively higher representation of larger-sized Ennominae in the trap catches is due to later flight activity or some behavioral differences related to body size. Diversity (measured as Fisher's alpha) of light tower catches decreased from clearings (22.4) and secondary forest (21.7) to mature forest (11.0), while in the traps, values increased in the same order (Fisher's alpha: 6.0, 12.0, and 14.2). Species composition of trap samples taken in clearings and secondary forest differed strongly from manual catches, while manual and automatic samples from mature forest were more similar to each other. Manual moth sampling at light towers proved superior to automatic light traps in many ways and is hence recommended as a very useful standard method to record nocturnal insects if sufficient man-power is available.

Additional key words: Geometridae, sampling method, tropical mountain rainforest, diversity assessment.

Nocturnal moths can easily be sampled by attracting them to artificial light sources. Two strategies of obtaining samples are frequently employed. Moths may be collected in light traps. Various types of these traps are commonly used (Taylor & Brown 1972, Taylor & French 1974, Baker & Sadovy 1978, Bowden 1982, Muirhead-Thomson 1991, Leinonen et al. 1998). Many light traps are run stationarily, as they are heavy, bulky and rely on permanent electric power supply, but more recently, light, robust types relying on batteries for power supply have become more widely available. Alternatively, moths may be collected manually from reflective sheets or gauze cylinders set up adjacent to a light (e.g. Beck et al. 2002, Chey 2002, Axmacher 2003, Brehm & Fiedler 2003, Schulze & Fiedler 2003). Both collecting methods yield samples that are amenable to statistical analysis, provided that proper measures are taken to standardize catches (Schulze 2000). Such samples can be used for addressing various ecological questions, such as the response of moth communities to environmental gradients or change (for geometrid moths e.g. Intachat et al. 1997, Intachat et al. 1999a, 1999b, Beck et al. 2002, Thomas 2002, Axmacher 2003, Brehm & Fiedler 2003).

Few studies have attempted to critically compare sampling success and sample composition from the same sites as a function of the sampling method. Many light trap studies employed strong (100-250 W) stationary light sources, while for hand sampling and portable traps, weak fluorescent tubes (8-15 W) are commonly used. It therefore remains difficult to directly compare results from such studies.

The aim of our study is to compare both manual sampling at a light tower and automatic sampling using a portable type of light trap. To facilitate comparisons, identical lamps were used in light towers and traps. Thus effects of different light spectra and intensities on the insects (e.g. Taylor & French 1974, Bowden 1982, Leinonen et al. 1998, Intachat & Woiwod 1999, Southwood & Henderson 2000) were eliminated.

Geometrid moths were selected as our study group since they have been often used as ecological indicators (Holloway 1985, Chey et al. 1997, Intachat et al. 1997, Intachat et al. 1999a, 1999b, Intachat & Woiwod 1999, Willott 1999, Kitching et al. 2000, Beck et al. 2002, Brehm et al. 2003). With about 21,000 known species (Scoble et al. 1995, Scoble 1999), this family is one of the most diverse in the order Lepidoptera.

MATERIAL AND METHODS

Study site. The study was conducted in the montane rainforest on the south western slopes of Mt. Kilimanjaro, Tanzania, in close vicinity to the Machame route at altitudes of about 2100 to 2300 m. Moths were caught in three different habitat types: large clearings (> 2500 m2, 3 sites), secondary forest (3 sites), and mature forest (6 sites).

Moth sampling. A small, robust type of automatic light trap (Fritz Weber, Germany, slightly modified,

Fig. 1) was used. The automatic light trap was arranged with the sampling bag just above the soil surface in order to avoid intrusion of army ants (*Dorylus* spp.). A total of seven traps were operated during the whole night from dusk to dawn (~1900 h to 0600 h), with 29 catches performed on clearings, 26 catches at secondary forest sites and 39 catches in mature forest.

Additionally, moths were sampled manually at three light towers (cylinder of reflective gauze, Fritz Weber, Germany, Fig. 2). On light towers, all geometrid moths were manually sampled from 1900 h to 2200 h. Twenty-two catches were performed on clearings, 16 in secondary forest and 11 in mature forest. Five nights before to four nights after full moon, sampling with both methods was stopped as the attractiveness of artificial light sources is reduced during this period (McGeachie 1989, Yela & Holyoak 1997, Schulze 2000, Brehm 2002).

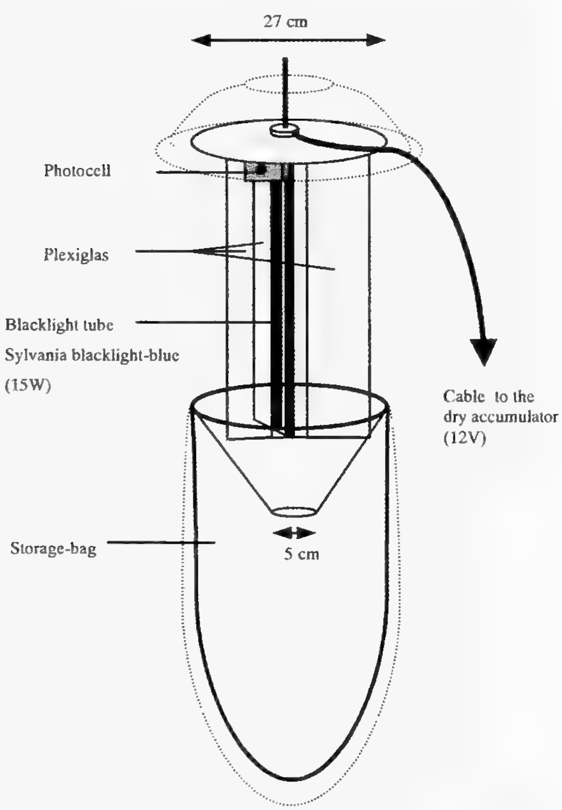

FIG. 1: Sketch of the light trap used in this study. Moths circle around the lamp until they collide with the Plexiglass and fall through the funnel into the storage bag below. For rain protection, a plastic bowl was fixed above the lamp, and the storage bag was put into a plastic bag (dotted lines). The storage bag was partly filled with leaves and twigs among which the moths could rest. A photoelectric element was used to ensure the operation of the lamp from dusk until dawn.

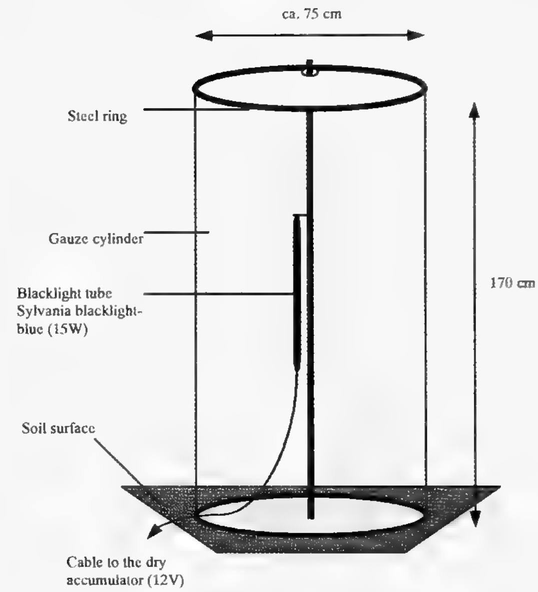

FIG. 2: Sketch of the light tower. Moths settle on the reflective gauze cylinder where they can be easily and selectively sampled.

Automatic light traps and light towers were equipped with a 15W-blacklight tube each (Sylvania Blacklight-Blue, F 15 W / BLB-TB) run on a 12V dry battery pack. This weak light source was aimed to ensure that moths were only attracted from a short radius, so that habitat-specific sampling was possible also in habitat mosaics. Earlier studies with the same equipment revealed that indeed such moth samples have a high spatial resolution (Schulze & Fiedler 2003, Fiedler & Schulze in press).

To avoid possible effects of seasonality on the comparison of the sampling techniques, for both methods only catches from the rainy seasons (1st March to 30th May and 1st -26th November) are considered in this study. Furthermore, samples were generally taken simultaneously at all three habitat types to make results more easily comparable. Site selection within the same habitat type was performed at random. To allow for meaningful statistical analyses, samples from different sites belonging to the same habitat type were pooled. Moths were sorted to morphospecies level and further determined as far as possible at the Zoologische Staatssammlung, Munich, where vouchers of all species will be deposited. A complete list of our specimens has been published (Axmacher 2003) and can also be obtained directly from the corresponding author.

Statistical analysis. χ^2-tests were employed to compare the effect of the sampling technique on the proportion of the subfamilies in the overall catches. Fisher's alpha (Fisher et al. 1943) was used to assess the

diversity of moths in different habitat types (with pooled samples exceeding 150 individuals in all cases) according to sampling methods. To evaluate the similarity between the pooled samples for each habitat type and for each sampling method, the chord-normalized expected species shared (CNESS) index (Trueblood et al. 1994) was employed. This index gives an approximation of the expected similarity of samples of an equal sample size (m) which can be varied from 1 to the smallest common maximal sample size. Setting m=1 strongly emphasises the most dominant species, while an intermediate level (m=50) and high values (m=100) give an increasingly strong emphasis to rare species. Based on the CNESS dissimilarity matrices, samples were ordinated using non-metric two-dimensional scaling for different values of the sample size parameter m (Brehm & Fiedler 2004). The software packages EstimateS 6.5 (Colwell 2000), COMPAH 96 (Gallagher 1999) and STATISTICA (Statsoft, Tulsa, UK) were used for analyses.

RESULTS

Effectiveness of methods. In the study area, 49 nightly manual catches at the light tower resulted in 2123 specimens representing 109 species of geometrid moths, while 94 nights of automatic light trapping yielded a total of 372 specimens representing 49 species. The average number of individuals caught in light traps was 4.0 specimens/night, whereas the light towers yielded approximately 43 specimens/3 h period (Table 1). Thus, manual samples of moths at light towers were on average more than ten times larger than trap catches. The maximum number of individuals found in a single trap was 20, while the minimum was 1. At the tower, the maximum number of geometrids recorded in a single, 3 h period was 239, the minimum 6. While between-habitat variation for sampling success of light traps was negligible, the effectiveness of light towers strongly increased from clearings and secondary to mature forest.

A comparison of species caught with the two methods showed that 42 species (36%) were present in both samples from light towers and light traps. Sixty-seven species (57%) were only found at the light towers, while 8 species (7%) were exclusively recorded in traps.

Subfamilial sample composition. Depending on the collecting method, samples differed strongly with regard to subfamily composition (Fig. 3 (A)). Larentiinae comprised 68% of all individuals caught at the light tower, compared to only 44% in the traps (χ^2=79.1; p<0.01; df=1). Conversely, the proportion of Ennominae specimens was 30% at the tower and 51% in the traps (χ^2=62.8; p<0.01; df=1). Geometrinae accounted for a slightly higher proportion in the traps than at the tower, while Sterrhinae occurred rarely at the light tower as well as in the traps. Desmobathrinae (overall very rare on the study sites) were never caught in the traps. When comparing the number of species belonging to different subfamilies (Fig. 3 (B)), the differences were much less pronounced. Larentiinae in both cases accounted for slightly more than half of the species, while Ennominae had a higher proportion in the traps, and there were proportionally more species of Geometrinae encountered at the light towers.

Two species of Larentiinae (*Mimoclystia corticearia* Aurivillius and *Chloroclystis derasata* Bastelberger) and the Ennomine *Darisodes oritropha* Fletcher were the three most dominant species at the light towers. These species were also among the four most dominant species in the traps, but they accounted for smaller proportions in the traps (17%, 10% and 9% respectively), than in the manual catches (26%, 9% and 20% respectively). In the trap catches, the Ennominae *Rhodophthitus arichannaria* Fletcher reached abundance rank two (44 individuals) whereas it was rarely encountered at light towers (12 individuals, rank 20).

Within-habitat diversity. Values of Fisher's alpha for different habitats differed significantly for both sampling methods, but the trends diverged strongly relative to the sampling method (Fig. 4). On clearings, samples attained at light towers showed the highest values for Fisher's alpha, whereas trap samples had the lowest values of all habitats investigated. Diversity was intermediate in secondary forest for both methods and peaked in mature forest when evaluated with light traps, while there was an overall decrease in diversity from clearings across secondary forest to mature forest for the catches at light towers.

Species composition. Ordinations using CNESS distances were performed for three different values of the sample size parameter m (Fig. 5). There is a general division between trap samples from secondary forest and clearings, and the remaining samples along the first dimension. Only trap catches in mature forest show a stronger similarity with the respective tower catches. This dissimilarity increases with an increasing sample size parameter m. The stress value of the ordinations as a measure of goodness of fit was <<0.01 in all cases, indicating that the ordinations precisely depict the original dissimilarity matrices.

DISCUSSION

Comparisons of samples attained with sampling at light towers and with light traps show that there are substantial differences in abundance and composition of

TABLE 1: Average number of Geometridae individuals, species, and individuals per catch recorded by nightly automatic light trap catches and manual 3 h catches in the different habitat types on Mt. Kilimanjaro, Tanzania.

Light trap	Catches	Individuals	Species	Individuals per catch
clearing	29	139	19	4.79
secondary forest	26	102	27	3.92
mature forest	39	131	33	3.45
all habitats	94	372	49	3.96

Light tower	Catches	Individuals	Species	Individuals per catch
clearing	22	534	72	24.27
secondary forest	16	578	71	36.13
mature forest	11	1011	50	91.91
all habitats	49	2123	109	43.33

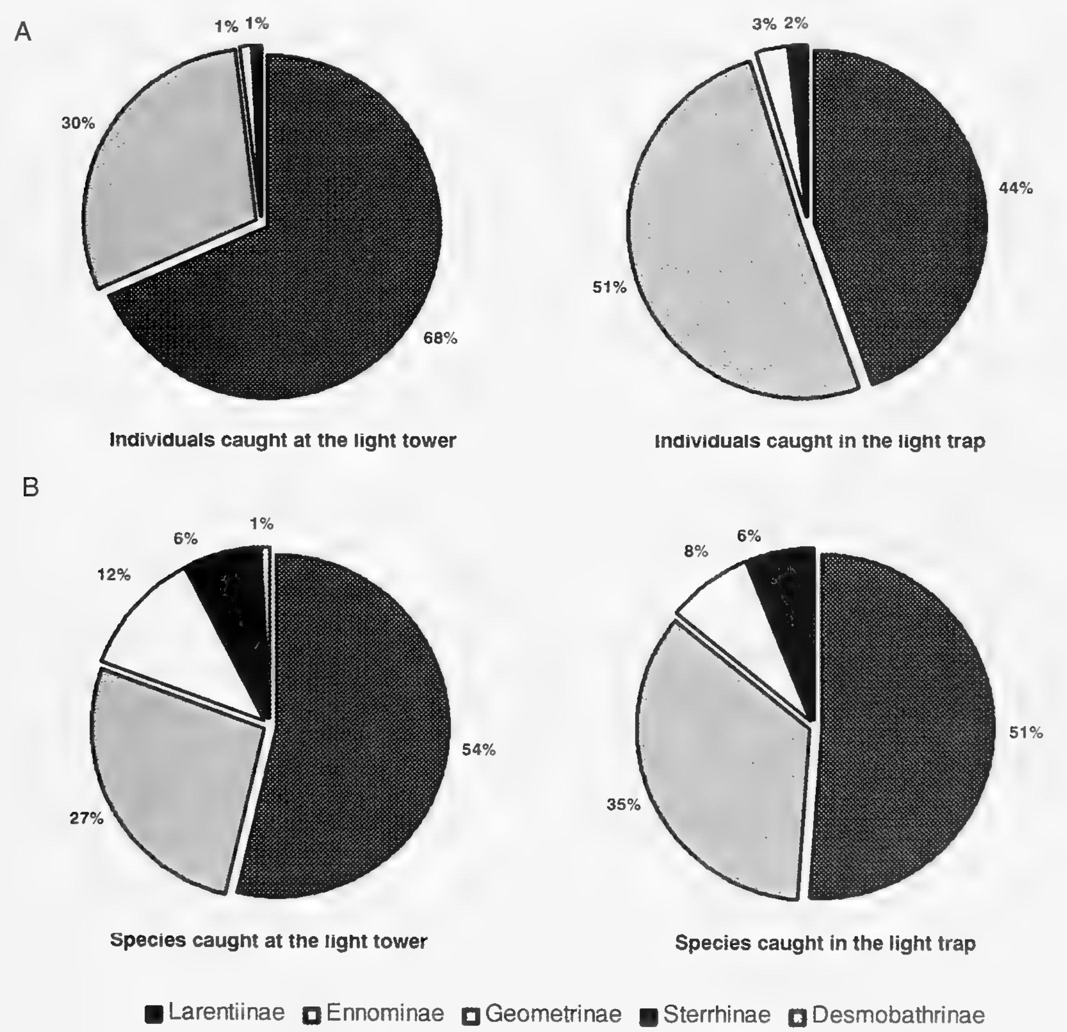

FIG. 3: Comparison of sampling methods with regard to subfamily spectra of (A) individuals and (B) species.

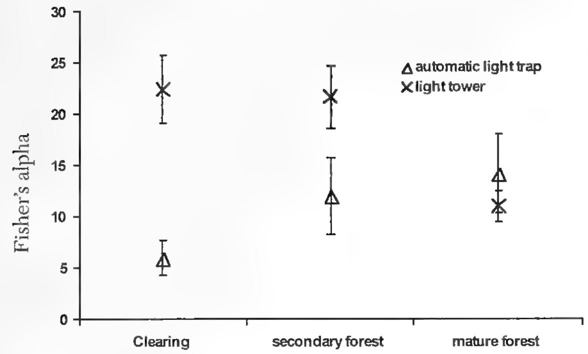

FIG. 4: Values of Fisher's alpha for the different habitats attained with light traps and at light towers. Whiskers show the 95% confidence interval. Pooled sample sizes exceed 100 individuals for each habitat.

such catches, even when identical light sources are used in the same habitats. Manual samples taken at light towers over 3 h intervals were on average ten times larger than automatic trap samples assembled over 11 h.

Overall, diversity and abundance of geometrid moths on Mt. Kilimanjaro is very low in comparison to other tropical forest ecosystems (Axmacher et al. 1994, in press). Nevertheless, the same tendency is obvious in other geographical regions. In Southeast Asia, light trap catches - mostly employing powerful types of lamps (125-250 W) - ranged from 10 to 31 geometrid moths per night (Barlow & Woiwod 1989, Intachat et al. 1997, Intachat & Woiwod 1999, Intachat & Holloway 2000). Trap catches in Australian tropical rainforest (8 W lamp) yielded an even lower average of only 6 geometrid moths per night (Kitching et al. 2000), which is in the same range as the catches on Mt. Kilimanjaro. In contrast, at light towers equipped with the same weak type of blacklight lamp as employed on Mt. Kilimanjaro, an average of 34 geometrid moths were caught on Borneo during 2.5 h nightly sampling periods (Beck et al. 2002). In the Ecuadorian Andes, the average number of geometrid individuals caught at light towers (with 2 x 15 W tubes) even exceeded 200 individuals during 3 h nightly catches (Brehm & Fiedler 2003).

Quantitative samples from temperate regions reveal the same differences. Here, the number of individuals caught in traps varies from less than 5 to 27 (Usher & Keiller 1998, Ricketts et al. 2002, Thomas 2002), whereas at light towers, an average of 50 geometrid moths were caught during 3 h sampling periods (Mühlenberg 1999). It can therefore be concluded that manual catches using light towers, albeit more laborious, generally result in a higher number of specimens caught per unit time than comparable light traps.

In our study, the number of moths arriving on the gauze of the tower decreased strongly after 2100 h. It is

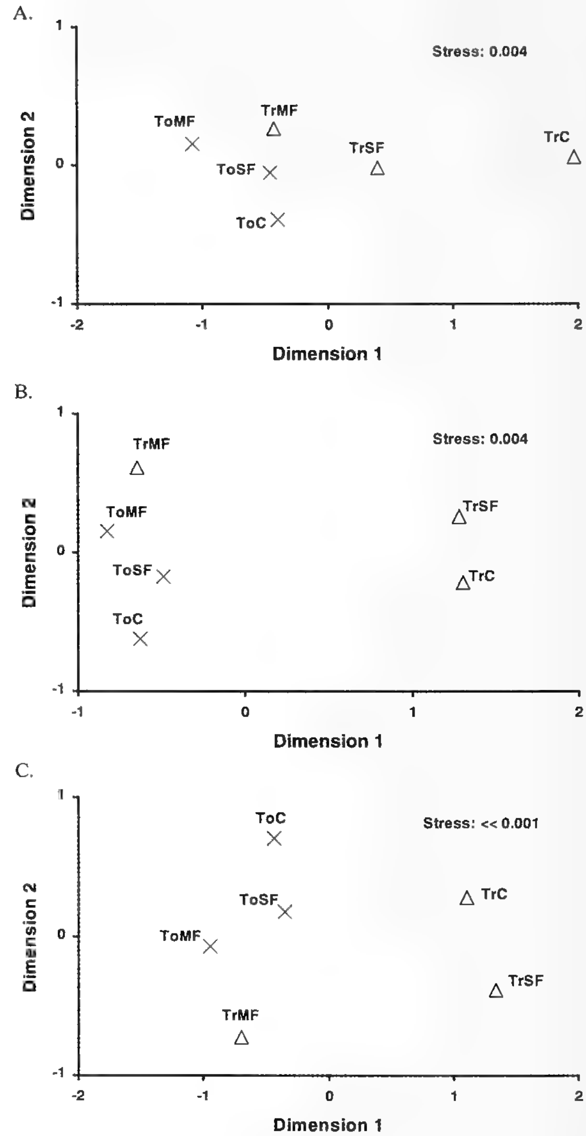

FIG. 5: Ordination diagrams (non-linear two-dimensional scaling) of moth samples based on CNESS distances (A: m=1, B: m=50, C: m=100, To: light tower, Tr: light trap, C: clearing, SF: secondary forest, MF: mature forest).

therefore likely that most geometrid species in the montane forest belt of Mt. Kilimanjaro show highest activity between 1900 h and 2100 h. The vast majority of species collected with the traps were also present in the catches at the light tower, which further supports this presumption. Therefore, a qualitative species inventory in an area is possible with light towers as they were operated in this study.

A few species were much more strongly represented in trap samples (e.g. *Rhodophthitus arichannaria*, *Xanthisthisa fulva* Warren, *X. tarsispina* Warren, *Cleora* c.f. *thyris* (all Ennominae); *Pingasa distensaria* Walker

(Geometrinae)). There are two possibilities to explain this phenomenon. These species may have later peaks of flight activity, reducing their likelihood of being sampled in the first 3 h of darkness. Remarkably, these species are all relatively large geometrid moths (wingspan: 2.9-5.5 cm). In contrast, Larentiinae moths (which are generally smaller than Ennominae, e.g. Brehm & Fiedler 2004a) were more strongly represented in the manual catches. Thus, an alternative explanation for differences between manual and automatic samples could be a systematic bias of the trap samples to larger-sized geometrids, perhaps due to characteristics in flight and behavior which are related to body size and design. This idea should be experimentally tested, since if true it would strongly challenge the representativeness of automatic trap samples with regard to species composition and diversity.

The much wider spectrum of species caught manually at the tower shows that only about half of all species of Geometridae attracted to the lamps used in this study were recorded in the light traps. Although this might also be partly related to differences in the size of the samples, also sample-size independent estimators of local diversity (such as Fisher's alpha) show that automatic light-trap samples tend to underestimate species diversity. Furthermore, with regard to species composition the smaller trap samples are not just impoverished subsets of the larger manual ones. Rather, as indicated by ordination results, the communities amenable to sampling by the two methods are not identical.

Our findings demonstrate that not only different light quality and trap types (Taylor & Brown 1972, Taylor & French 1974, Muirhead-Thomson 1991, Leinonen et al. 1998), but also the method of sampling itself has a major impact on species number, diversity and composition of light trap samples. This makes comparisons between different studies more complicated. Moreover, our results raise doubts whether with automatic light traps - at least among the Geometridae - important fractions of the fauna (e.g. small-bodied Larentiinae) are generally strongly under-sampled.

For the future, it therefore seems advisable to standardize methods of recording nocturnal insects. In this regard, light towers proved not only to be a robust and flexible equipment, but also very effective albeit labor intensive and catching a wider spectrum of species than the traps. Especially when effectiveness of the sampling is central, e.g. when studying remote areas or habitats slated for destruction, we strongly propose manual sampling. Finally, when equipped with weak light sources such manual samples also allow for an assessment of moth ensembles with a high spatial or temporal resolution (Schulze et al. 2001, Beck et al. 2002, Axmacher 2003, Schulze & Fiedler 2003).

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BUTTERFLIES OF THE STATE OF NAYARIT, MEXICO

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ABSTRACT. A list of the Rhopalocera of the state of Nayarit, Mexico, is presented, which includes 538 species from 276 genera and 5 families. The list is presented in a synthetic manner, mentioning the localities, months of occurrence, and source of every record for each species. Based on this list, previous equivalent faunal works by Vargas et al. (1996), Warren et al. (1998) and Luis et al. (in prep.) for the states of Jalisco, Colima, and Michoacán, respectively, Nayarit's species are classified according to their distribution within these four states; 74% of the total number of species in Nayarit are shared with the other three states, while 5% of the species are known in the region only from Nayarit.

Additional key words: distribution, Hesperioidea, Papilionoidea, Jalisco, Colima, Michoacán.

RESUMEN. Se integró la lista de los Rhopalocera del estado de Nayarit, México, que suma 538 especies, de 276 géneros y cinco familias. Ésta se presenta de manera sintética mencionando las localidades, meses de ocurrencia y las colecciones o fuentes de información. Con base en la presente lista, los trabajos equivalentes previos de Vargas et al. (1996), Warren et al. (1998) y de Luis (en prep.) para los estados de Jalisco, Colima y Michoacán, respectivamente, se clasificó a las especies de acuerdo con su distribución en esos cuatro estados, obteniéndose que el 74% del total de especies de Nayarit se comparte con los otros tres estados y que el 5% del mismo es exclusivo para ese estado.

Palabras clave adicionales: distribución, Hesperioidea, Papilionoidea, Jalisco, Colima, Michoacán.

This study adds to our knowledge of the distribution of western Mexican butterflies, initiated by the works of Vargas et al. (1996) for Jalisco and Warren et al. (1998) for Colima. Similar lists for the states of Nayarit (herein) and Michoacán (Luis et al. in prep.) have been developed to further our objective, given that these are the states situated to the north, and south (respectively) of Jalisco and Colima, and share much of the same fauna.

HISTORY OF BUTTERFLY STUDIES IN NAYARIT

The butterfly fauna of Nayarit has received very little formal study. The volumes by Godman and Salvin (1879-1901) contain the first published records of species from the state, listing 23 Hesperioidea and 53 Papilionoidea species. Nayarit material studied by Godman and Salvin was reported as being from three localities: the Sierra Medre de Tepic (34 spp.), San Blas (17 spp.) and the Islas Tres Marias (12 spp.).

The next works to present a significant number of records for Nayarit butterflies are those by Hoffmann (1940, 1941); 15 species of Hesperioidea and 9 species of Papilionoidea were reported, mostly from "Nayarit." Hoffmann listed three specific localities within Nayarit, the Sierra Madre de Nayarit (1 sp.), the Sierra Madre Occidental (1 sp.) and the Islas Tres Marias (1 sp.).

More recently, Beutelspacher (1984) presented records of 12 species of Papilionidae from Nayarit, from Ahuacatlán (1 sp.), Compostela (2 spp.), Carretera Puerto Vallarta (1 sp.), Islas Tres Marias (1 sp.), La Colonia (1 sp.), Mirador del Águila (1 sp.) and San Blas (1 sp.). De la Maza (1987) presented records for 2 Hesperioidea and 48 Papilionoidea species, from several localities: Compostela (2 spp.), Cruz de Juanacaxtle (4 spp.), El Palillo (1 sp.), La Bajada (2 spp.), La Libertad (1 sp.), La Yerba (3 spp.), Lima de Abajo (8 spp.), San Blas (10 spp.), Singayta (2 spp.), Venustiano Carranza (6 spp.).

As shown above, San Blas is one of the classic sites that has been most frequently collected. Additionally, the Lepidoptera collection at the Los Angeles County Museum, California, houses 37 species from San Blas collected by the following collectors between the years of 1956 and 1970: M. Bell, J.C. Spencer, Rubbert and A.R. Gillogly. The collection at the California Academy of Sciences (San Francisco) houses 24 species from San Blas collected by D. Giuliani, Allen, Davies, G.E. Heinsohn, Ernest R. Tinkham, Smith and Bill Patterson.

Llorente (1979) obtained a list of 185 butterfly species in an altitudinal transect including several types of vegetational zones, running from the coast at San Blas, over the Sierra de San Juan, to Tepic; the results of this study only included the Papilionoidea. The addition of Hesperiidae in our present study, as well as additional field research since 1979, has raised these numbers significantly.

STUDY AREA

The state of Nayarit is subtropical, its surface occupies 26,979 km^2 and is composed of 19 municipalities. The predominate climatic conditions along the coast and in lower portions of the Río Huaynamota and Río San Pedro drainages are warm to hot. Progressively cooler climates are encountered with an increase in elevation. From a geological point of view, Nayarit is componed of parts of four geological provinces, of which, the Sierra Madre Occidental occupies the eastern half (SPP 1981). The principal drainage of the Sierra Madre Occidental forms the Acaponeta and San Pedro Rivers, as well as the Río Grande de Santiago. The westernmost geological province, the Llanura Costera (or coastal plain) is dominated by sandy shores and swamps, characterized by sedimentary deposits dated to the quaternary period. According to Escalante (1988), the highest points in the state are Cerro El Vigía (2740 m), Volcán Sangangüey (2300 m), and Volcán San Juan (2200 m). Soil and rock types in the state are primarily igneous in their origins.

The Islas Tres Marías are geographically related to the state of Nayarit, and are situated at a distance of 80 km to the west of the closest point on the western Mexican mainland (Escalante 1988).

According to INEGI (1988) and SAHOP (1981), eleven vegetational types occur in Nayarit, with tropical semi-deciduous forest predominating, covering almost one third of the area of the state.

Flores and Gerez (1994) indicate that the flora and fauna of Nayarit have been only partially studied; however 227 species of vertebrales endemic to Mesoamerica and 127 species endemic to Mexico are know from Nayarit. The state contains two protected areas which cover about 1% of the terrirory: Isla Isabel and Sierra de San Juan.

MATERIALS AND METHODS

Collections and Literature. The following sources and institutional collections have been consulted during the course of this study: ADW = Recorded by Andrew D. Warren; AME = Allyn Museum of Entomology (now the McGuire Center for Lepidoptera Research, Gainsville, Florida); AMNH = American Museum of Natural History (New York City); BMNH = The Natural History Museum (London, England); CAS = California Academy of Sciences (San Francisco); CIB = Instituto de Biología, UNAM (México City); CMNH = Carnegie Museum of Natural History (Pittsburgh, Pennsylvania); CUIC = Cornell University Insect Collection (Ithaca, New York); HAF = Hugh Avery Freeman, pers. comm. 1989-1998 (Garland, Texas); JPB = James P. Brock, pers. comm. 1993-1998 (Tucson, Arizona); LACM = Los Angeles County Museum (California); MZFC = Museo de Zoología, Facultad de Ciencias, UNAM (México City); NSMC =Nevada State Museum Collection (Las Vegas); PMNH = Peabody Museum of Natural History, Yale University (New Haven, Connecticut); RES = Ray E. Stanford Collection (Denver and Fort Collins, Colorado); RH = Recorded by Richard Holland, (Albuquerque, New Mexico); SDNHM = San Diego Natural History Museum (California); UCB = Essig Museum of Entomology, University of California (Berkeley); USNM = United States National Museum, Smithsonian Institution (Washington, D.C.).

Additionally, the following works containing distributional records for the state of Nayarit were consulted: Austin & Warren (2001, 2002), Austin & Smith (1998), Bauer (1960), Beutelspacher (1976, 1984), Boullet & Le Cerf (1912), Clench (1966, 1972), De la Maza & Turrent (1985), De la Maza, E.R. (1980), De la Maza, R.R. (1987), Field (1967), Freeman (1966, 1979), Friedlander (1986, 1987), Gibson & Carrillo (1959), Godman & Salvin (1879 1901), Hall (1999), Higgins (1960), Hoffmann (1933, 1940, 1941), Jenkins (1983, 1984, 1985, 1986, 1990), Jurado (1990), Kendall & McGuire (1984), Lamas (1979), Llorente (1985, 1988), Mc Alpine (1971), Miller (1974, 1978), Miller & De la Maza (1984), Nicolay (1976, 1979), Robbins (1991), Robbins et al. (1996), Steinhauser & Warren (2002), Vargas et al. (1996), Vázquez (1989), Vázquez & Zaragoza (1979), Warren (1998, 2000), Warren et al. (1998), Warren & Llorente (1999), Wilmott & Hall (1999).

Some of the names used for taxa listed herein differ from names used in previous works by Vargas et al. (1996) and Warren et al. (1998). For Hesperioidea, these changes have been made in order to follow the nomenclature of Warren (2003) and Opler and Warren (2002), which incorporate changes based on recent published research. For Papilionoidea, these changes have been made mostly in order to follow the nomenclature adopted by Llorente et al.'s (in prep.) checklist of Mexican butterflies, and names usually follow Lamas' (in prep.) checklist of Neotropical butterflies. All changed names are indicated in the list, with the previous name listed following the current one (except changes from binomial to trinomial status, or vice versa, when no new name is introduced).

Fieldwork. During the years 1978 to 1982, personnel from the MZFC made systematic collections in the southeastern part of the state (Sierra de San Juan), which primarily included the following localities: Jumatán, La Bajada, La Yerba, Mecatán, Palapita,

Pintadeño, San Blas, San Quintín, Singayta and Venustiano Carranza (Table 1). Recently (1996-1998) the second and fourth authors have made collections at some of these localities, as well as others (El Refilión, El Guamúchil, Rancho La Noria); data from these recent collections have added to the previous list of species, especially in the families Lycaenidae and Hesperiidae.

RESULTS

Our review of the literature and collections has resulted in a list of 538 butterfly species, in 276 genera and 5 families (24 Papilionidae, 37 Pieridae, 144 Nymphalidae, 114 Lycaenidae and 219 Hesperiidae). An analysis of this list has resulted in Table 1 and Fig. 1, which include the richest localities in the state, in terms of known species numbers.

The localities in the Sierra de San Juan include San Blas (0-10 m), Singayta (20-150 m), La Bajada (110-400 m), Mecatán (150-400 m), Jumatán (300-400 m), Palapita (500-900 m), La Yerba (800-950 m), Tepic (970 m), Venustiano Carranza (950-1300 m), and Rancho la Noria (1540-1600 m), and include various vegetational zones from mangrove and coastal thorn scrub at San Blas to Pine-Oak Cloud Forest at Rancho la Noria (see Table 1).

Based on equivalent faunal works by Vargas et al. (1996) for the state of Jalisco and Warren et al. (1998) for Colima, as well as the study by Luis et al. (in prep.) for Michoacán, and the the present study, a matrix of distributional data was assembled for the 776 species of Rhopalocera distributed within these four states. This matrix was then used to generate Fig. 2, showing that the majority of Nayarit's butterfly fauna (74%) is shared with the three states aligned to the south of it (Jalisco, Colima and Michoacán), while at present 5% are known in this region only from Nayarit. These numbers will change as our knowledge of these areas improves. At present, 651 species are included in the study by Luis et al. (in prep.) for Michoacán, as a result of a very significant labor force.

Figure 2 is useful for showing that, while about 74% of Nayarit's known species can be considered widely distributed in the region, distributional information for 26% of Nayarit's species is spotty and probably incomplete, region-wide. This figure also shows that the sites surveyed have a strong faunal affinity to the states directly to the south. We feel that this is part reality (many habitats types in the Sierra de San Juan do not

TABLE 1. Descriptions of the richest Nayarit collecting sites, with numbers of known species and vegetation types. Abbreviations in the left column are used in the species list to represent these localities.

Rank°	Code	Locality and Altitude (m.)	Vegetation Type	Number of Species
1	JUM	Jumatán, 300-400	Tropical Deciduous Forest	249
2	LBA	La Bajada, 110-400	Tropical Semi-Deciduous Forest	228
3	MEC	Mecatán, 150-400	Tropical Semi-Deciduous Forest	223
4	SIN	Singayta, 20-150	Palm Forest dominated by *Orbignya cohune*	212
5	LYB	La Yerba, 800-950	Tropical Semi-Deciduous Forest - Pine-Oak Cloud Forest	166
6	SB	San Blas, 0-10	Mangrove and Coastal Thorn Scrub	152
7	VC	Venustiano Carranza, 950-1300	Pine-Oak Cloud Forest	147
8	PAL	Palapita, 500-900	Tropical Semi-Deciduous Forest	142
9	EREF	El Refilión, 780	Tropical Semi-Deciduous Forest - Pine-Oak Forest	127
10	LSMO	Laguna Santa María del Oro, 840	Tropical Semi-Deciduous Forest	126
11	EGUM	El Guamúchil (km 131, Hwy 200), 100	Tropical Semi-Deciduous Forest	114
12	RLNO	Rancho La Noria, 1540-1600	Pine-Oak Cloud Forest	106
13	COM	Compostela, 860	Tropical Semi-Deciduous Forest - Pine-Oak Forest	106
14	TEP	Tepic, 970	Tropical Semi-Deciduous Forest - Pine-Oak Forest	94
	NAY	Estado de Nayarit	various	88
	NVO	Nuevo Vallarta, 0-5	Coastal Thorn Scrub	81
	BUC	Bucerias, 0-5	Coastal Thorn Scrub	59

°The numbers at left correspond to the localities indicated on the map in Figure 1.

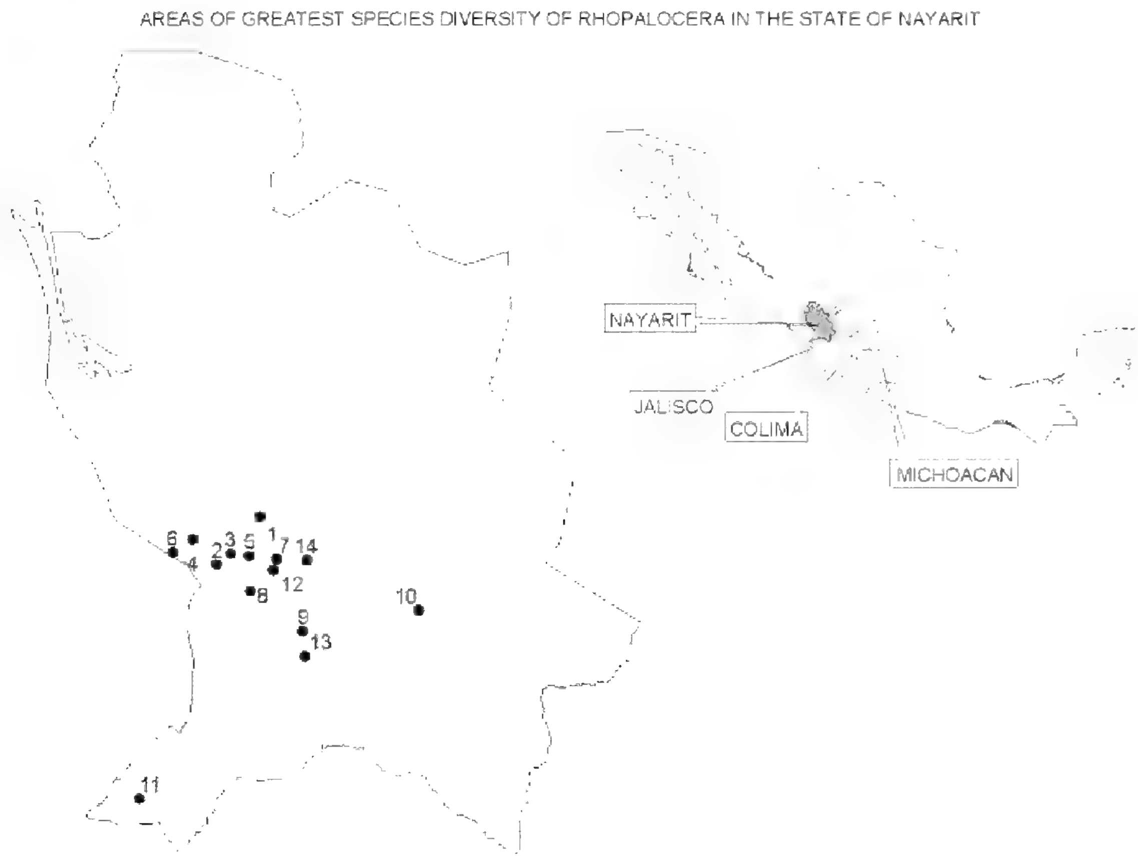

FIG. 1. Map of Nayarit, showing its position in western Mexico, with respect to Jalisco, Colima and Michoacán). Numbered localities refer to localities listed in Table 1, the richest known sites in the state in numbers of butterfly species.

extend into Sinaloa to the north), and in part an artifact of where surveys were conducted in Nayarit. The largely inaccesible north-eastern third of Nayarit remains virtually unknown for butterflies, and its fauna would presumably show strong faunal influences from the Sierra Madre Occidental. Great potential remains for adding new species to the list presented herein from the north-eastern third of the state.

We feel that most of the species known from three of these four western states will eventually be found to occur in all four states with continued fieldwork. Some species known from only one or two of these states may represent cases of disjunctly distributed taxa (such as *Phanus rilma* Evans 1952, *Astraptes phalaecus* (Godm. & Sal. 1893), *Synapte silna* Evans 1955, *Naevolus orius* (Mabille, 1883), *Quasimellana nayana* (Bell, 1941), *Hypanartia dione* ssp., *Dynamine artemisia* ssp., *Prepona deiphile lambertoana* Llorente, Luis & González, 1992, *Fountainea nobilis rayoensis* (J. Maza & Díaz 1978), and *Nesiostrymon calchina* (Hewit. 1868)), stray individuals (such as *Dryadula phaetusa* (L. 1758) and *Eueides isabella eva* (Fabr. 1793)), or cases of species that reach the limits of their geographical range in our study area (such as the northern population of *Amblyscirtes brocki* H. A. Freeman 1992, known to the north from Sonora). Many of these cases (such as *Joanna joanna* Evans 1955 known in Mexico from Nayarit, San Luis Potosí and Tamaulipas), however, have no obvious explanation and illustrate the need for further fieldwork in the region to clarify these distributional patterns.

BUTTERFLIES OF NAYARIT

The following list is presented in the same manner as recent lists for the states of Jalisco (Vargas et al. 1996) and Colima (Warren et al. 1998), and species are listed in approximately the same order. Localities each taxon is known from are listed roughly alphabetically. Most localities have been abbreviated; a complete listing of these is presented in Table 1. Localities are followed by the months (in lowercase Roman numerals) from which the species is known from that locality. For several

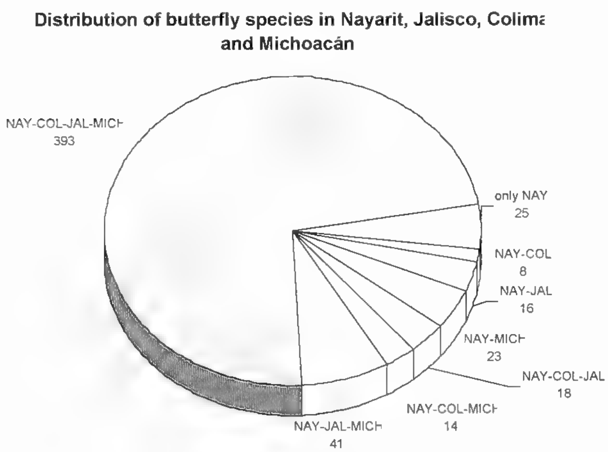

FIG. 2. Numbers of Nayarit's butterfly species that are shared among other western Mexican states. Data taken from this study, Vargas et al. (1996), Warren et al. (1998) and Luis et al. (in prep.) for Michoacán.

literature records (and rarely for specimens), no phenological data was provided with the locality record. The source for each record is provided: abbreviations for collections where the specimens are housed (see Materials and Methods), or literature citations (author and year) of the consulted source. In cases where literature records exist for the same specimens that were examined, the literature records may or may not be cited, but collection citations usually are.

Each taxon name and author is followed by one to three capital letters (J, C and / or M), which refer to other western Mexican states (Jalisco, Colima and Michoacán) from which that taxon is known from, at the time this study was submitted for publication. If none of these letters follow a species in the list, that species is not known from any of these other three states. Distributional data from these states (except Nayarit, presented herein, see also Warren & Llorente 1999) are taken from Vargas et al. (1996) for Jalisco, Warren et al. (1998) for Colima, and Luis et al. (in prep.) for Michoacán, with the exception of records obtained since the publication of these studies.

For example, see the entires for the first species listed, *Chalypyge chalybea chloris* (Evans 1951). The passage essentially says: the species is also known from Jalisco, Colima, and Michoacán States; specimens from Bucerias from January are in the Warren collection; specimens from vic. Compostela from October are in the Cornell University Insect Collection; specimens from Jumatan from September are in the Museo de Zoología; specimens from La Bajada from January are in the Warren collection; specimens from La Yerba from October are in the Museo de Zoología; specimens from Mecatan from January, June and December are in the Warren collection; Hoffmann (1941) reported a general "Nayarit" record, and specimens labeled as such from the Hoffmann collection are in the American Museum of Natural History. See Vargas et al. (1996:105) for additional discussion on how the entries for each taxon were constructed and how they should be read.

HESPERIIDAE (219 SPECIES)

Chalypyge chalybea chloris (Evans 1951), as *Pyrrhopyge chloris* in Warren et al. (1998), J C M. BUC i (ADW); COM, vic. x (CUIC); JUM ix (MZFC); LBA i (ADW); LYB x (MZFC); MEC i,vi,xii (ADW); NAY ix (Hoffmann 1941: AMNH). See Mielke (2002) for generic change; see Austin & Warren (2002) for specific change.

Apyrrothrix araxes araxes (Hewit. 1867), as *Pyrrhopyge a. araxes* in Warren et al. (1998), J C M. EREF x (ADW); Jasmine, 3.5 mi W on Hwy 15 vii (RES); RLNO ix (ADW, MZFC); TEP vii (HAF); VC vi,x (MZFC). See Mielke (2002) for generic change. Nayarit *araxes* are very large, compared to typical *araxes*.

Elbella scylla (Mén. 1855), J C M. EGUM x; EREF x (ADW); JUM ix (ADW, MZFC); MEC x (ADW); NAY ix; SB, 14 mi E ix (AMNH); SIN iv (MZFC); TEP ix (AMNH).

Mysoria amra (Hewit. 1871), J C M. COM, vic. x (CUIC); EGUM x; EREF x; JUM ix,xii (ADW), x (MZFC); Las Piedras x; LSMO ix (ADW); MEC vi,ix (MZFC), vi,x (ADW, MZFC); NAY (coastal) (Hoffmann 1941); Paso de Mesillas (km 54, Hwy 200) x (ADW); Playas Novillero vi (AMNH), xii (PMNH); SB (Godman & Salvin 1879-1901); SIN ix (MZFC), xii (ADW).

Mysoria affinis (Herr.-Sch. 1869), J C M. COM ix (HAF); NAY (Hoffmann 1941); TEP ix (AMNH).

Phocides polybius lilea (Reak. 1867), as *P. palemon lilea* in Warren et al. (1998), J C M. EREF x; JUM i,xii (ADW); NAY ix (AMNH). See Opler & Warren (2002) for specific change.

Phocides belus Godm. & Salv. 1893, J C M. LBA i (ADW); SB ix (MZFC); SIN xii (ADW). It is unknown if Hoffmann's (1941) records of *P. belus* from NAY refer to *belus* or the following species.

Phocides sp. NVO i (ADW); SB (BMNH). Apparently an undescribed species.

Phocides urania (Westw. [1852]), M. COM, vic. xi (CUIC).

Phanus albiapicalis Austin, 1993, M. JUM xii; LBA i (ADW); LYB ix,x (MZFC); SIN xii (ADW).

Phanus rilma Evans 1952. LBA i (ADW); LYB ix (MZFC); MEC x (ADW).

Phanus marshalli Kirby 1880, J. EGUM xii; LBA i (ADW); NAY (AMNH).

Udranomia kikkawai (Weeks 1906), J. LBA i (ADW).

Proteides mercurius mercurius (Fabr. 1787) J C M. JUM xi (MZFC).

Epargyreus windi H. A. Freeman 1969, J C M. EGUM x; LBA i,vi; MEC vi,x (ADW); TEP ix (AMNH); Zapata, 3 mi SE viii (AME).

Epargyreus exadeus cruza Evans 1952, J C M. MEC x (ADW); TEP, 22 mi NNW on Hwy 15 (at Jct Hwy 54) viii (AME).

Epargyreus aspina Evans 1952, C M. JUM ix; LSMO ix; MEC vi,x (ADW); SB viii (HAF); TEP, 22 mi NNW on Hwy 15 (at Jct Hwy 54) viii; Zapata, 3 mi SE viii (AME).

Epargyreus spina spina Evans 1952, J C M. MEC x (ADW).

Epargyreus spinosa Evans, 1952, J C M. MEC vi (ADW).

Epargyreus sp., J C M. MEC x (ADW). Possibly an undescribed species.

Polygonus leo arizonensis (Skinner 1911), J C M. JUM xii; LSMO ix (ADW).

Polygonus savigny (Latr., [1824]), as *P. m. manueli* Bell & Comstock 1948 in Warren et al. (1998), J C M. BUC, 7 mi N viii (RES); JUM i; LBA i; MEC i (ADW). See Mielke & Casagrande (2002) for taxonomic change.

Chioides albofasciatus (Hewit. 1867), as *C. catillus albofasciatus* in Warren et al. (1998), J C M. Aticama xii (ADW); COM, 3 mi N viii (AME); EREF xii (ADW); Francisco I. Madero viii (AME); JUM i,ix,xii; LBA i (ADW), vi (MZFC); LSMO ix (ADW); MEC i (MZFC); NAY vi,viii,ix (AMNH); NVO xii (ADW); PAL iii

(MZFC); SB (Godman & Salvin 1879-1901), ix (AME); TEP ix (AME); VC iii (MZFC); Zapata, 3 mi SE viii (AME). See Austin & Warren (2002) for taxonomic change.

Chioides zilpa (Butl. 1872), J C M. EGUM x; JUM ix (ADW); LSMO viii; Zapata, 3 mi SE viii (AME).

Aguna asander asander (Hewit. 1867), J C M. Aticama xii (ADW); BUC, 7 mi N viii (RES); COM, 3 mi N viii (AME); JUM i,xii; LBA i; MEC i,vi,x,xii (ADW); NAY iv (AMNH); RLNO i,ix; SB i; SIN xii (ADW), iv (MZFC); TEP, 22 mi NNW on Hwy 15 (at Jct Hwy 54) viii (AME); VC iv,xi (MZFC); Zapata, 3 mi SE viii (AME).

Aguna metophis (Latr. [1824]), J C M. BUC i; JUM xii; LBA i; MEC i,xii; SIN xii (ADW).

Typhedanus undulatus (Hewit. 1867), J C M. COM, vic. viii (AMNH); EREF x; JUM ix; MEC x (ADW); Playas Novillero xi (AMNH).

Polythrix octomaculata (Sepp [1844]), J C M. JUM i (ADW); NAY ix (AMNH); Zapata, 3 mi SE viii (AME).

Polythrix asine (Hewit. 1867), J C M. BUC i (ADW); Islas Tres Marías (BMNH); JUM ix; LBA i,vi; MEC x (ADW); Zapata, 3 mi SE viii (AME).

Codatractus carlos Evans 1952, J M. LBA i (ADW).

Codatractus alcaeus (Hewit. 1867), J M. LBA i (ADW).

Codatractus sallyae A. Warren 1995, J C M. EREF x (ADW).

Codatractus melon (Godm. & Salv. 1893), J C M. Puerto Vallarta, 20 mi N viii (AMNH).

Codatractus bryaxis (Hewit. 1867), J C M. NAY vii (AMNH).

"*Codatractus*" *hyster* (Dyar 1916), J C M. COM, 3 mi N viii; LSMO viii (AME).

Urbanus proteus proteus (L. 1758), J C M. BUC xii (ADW); COM, 3 mi N viii; Francisco I. Madero viii (AME); JUM i,ix,xii; LBA i (ADW); LSMO viii (AME); MEC i (MZFC); NVO i,xii (ADW); SB ix (HAF); SIN ix (MZFC), xii (ADW); TEP ix (AMNH); TEP, 2.5 mi NW viii (AME).

Urbanus viterboana (Ehrm. 1907), J M. JUM xii (ADW); NAY v (AMNH); PAL iii (MZFC).

Urbanus belli (Hayward 1935) J C M. COM, 3 mi N viii (AME); EGUM xii; EREF x; JUM i,ix,xii; LBA i; MEC i,vi,x,xii; RLNO ix; SIN xii (ADW); TEP, 22 mi NNW on Hwy 15 (at Jct Hwy 54) viii (AME).

Urbanus pronta Evans 1952, J C M. LBA i; MEC i,x (ADW).

Urbanus esmeraldus (Butl. 1877), J C M. JUM i,ix,xii; LBA i; MEC i,x; SIN xii (ADW); VC iii (MZFC).

Urbanus evona Evans 1952, J C M. MEC i (ADW).

Urbanus esta Evans 1952, J C M. JUM xii; LBA i; MEC vi; SIN xii (ADW); Zapata, 3 mi SE viii (AME).

Urbanus dorantes dorantes (Stoll 1790), J C M. BUC xii (ADW); COM, 3 mi N viii (AME); EGUM i,x,xii; EREF x,xii (ADW); Francisco I. Madero viii (AME); JUM i,ix,xii (ADW), iii,xi (MZFC); LBA i (ADW), vi,xii (MZFC); Las Piedras x; LSMO ix (ADW), viii (AME); LYB vi (MZFC); MEC i,x,xii (ADW), vi (MZFC); Paso de Mesillas (km 54, Hwy 200) x; NVO i,xii (ADW); Playas Novillero x (AMNH); RLNO i,ix,xii; SB i,vi (ADW), vii (HAF), ix,xii (MZFC); San Francisco xii; SIN xii (ADW), iv,ix (MZFC); TEP (Godman & Salvin 1879-1901), ix (AMNH); TEP, 2.5 mi NW viii; TEP, 22 mi NNW on Hwy 15 (at Jct Hwy 54) viii (AME); VC vii,xi (MZFC); Zapata, 3 mi SE viii (AME).

Urbanus teleus (Hübner 1821), J C M. COM, 3 mi N viii (AME); EREF x,xii; JUM i,ix,xii; LBA i; LSMO ix (ADW), viii (AME); MEC i,x,xii; RLNO ix; SIN xii (ADW); Zapata, 3 mi SE viii (AME).

Urbanus simplicius (Stoll 1790), J C M. BUC xii (ADW); COM, 3 mi N viii (AME); EREF x; JUM i,ix,xii; LBA i (ADW), ix,x (MZFC); LSMO ix (ADW); LYB ix (MZFC); MEC i,vi,x,xii (ADW), ix (MZFC); SB vi (ADW); SB, 14 mi E ix (AMNH); SIN ix (MZFC), xii (ADW); TEP (BMNH); TEP, 22 mi NNW on Hwy 15 (at Jct Hwy 54) viii; Zapata, 3 mi SE viii (AME).

Urbanus procne (Plötz 1881), J C M. Aticama xii (ADW); COM, 3 mi N viii (AME); EREF x; JUM i,ix,xii (ADW), iv (MZFC); LBA i; LSMO ix (ADW); MEC i,x,xii (ADW); Playas Novillero xi (AMNH); SB vi (ADW), xi (AME); SIN xii (ADW); TEP (BMNH), viii,ix (AMNH).

Urbanus doryssus chales (Godm. & Salv. 1893), J C M. JUM ix,xii; LBA i; MEC x (ADW); NAY ix (AMNH); San Francisco xii; SIN xii (ADW).

Astraptes fulgerator azul (Reak. [1867]), J C M. BUC i,xii; EGUM xii; EREF x; LBA i (ADW); LYB v (MZFC); MEC vi,x (ADW); NAY viii,ix (AMNH); NVO i,xii (ADW); SB i (MZFC); SIN xii (ADW), ix (MZFC); VC iii,xi (MZFC); Zapata, 3 mi SE viii (AME).

Astraptes egregius (Butl. 1870), J C M. EGUM xii; LBA i; MEC i,vi; SIN xii (ADW).

Astraptes phalaecus (Godm. & Salv. 1893). SIN xii (ADW).

Astraptes enotrus (Stoll 1781), M. LBA i (ADW).

Astraptes megalurus (Mab. 1877), C M. NAY (Hoffmann 1941).

Astraptes alector hopfferi (Plötz 1882), J C M. COM, vic. v,x (CUIC); JUM ix,xii (ADW), xi (MZFC); LSMO ix (ADW), viii (AME); MEC xii (ADW), x (MZFC); NAY ii,iv,viii,ix (AMNH); SIN xii (ADW).

Astraptes anaphus annetta Evans 1952, J C M. EGUM i,x; EREF x; JUM i,x,xii (ADW), xi (MZFC); LBA i (ADW), ix (MZFC); LSMO ix; MEC i,vi,x,xii (ADW); NAY viii,ix (AMNH); Paso de Mesillas (km 54, Hwy 200) x (ADW); Playas Novillero xii (AMNH); SB i; SIN xii (ADW); TEP (BMNH).

Narcosius parisi helen Evans 1952, J C M. LBA i; SIN xii (ADW).

Autochton cellus (Boisd. & LeC. [1837]), J M. RLNO ix (ADW); VC vi (MZFC).

Autochton pseudocellus (Coolidge & Clemence [1910]), J M. NAY (K. Roever, pers. comm. to ADW).

Autochton cincta (Plötz 1882), J C M. RLNO i,vi,ix (ADW); VC iii,x (MZFC).

Autochton neis (Geyer 1832), J C M. EGUM i; JUM xii; LBA i,vi (ADW); LSMO viii (AME); LYB ix (MZFC); MEC x,xii (ADW); NAY vii (AMNH); RLNO ix; SIN xii (ADW); TEP (BMNH); VC xi (MZFC).

Thessia jalapus (Plötz 1882), J. MEC iv (MZFC).

Achalarus casica (Herr.-Sch. 1869), J C M. NAY vii (AMNH).

Achalarus albociliatus albociliatus (Mab. 1877), J M. LSMO ix; MEC x (ADW).

Achalarus toxeus (Plötz 1882), J C M. BUC i,iii,xii; EGUM xii; EREF x (ADW); Francisco I. Madero viii (AME); JUM ix,xii; LSMO ix; MEC x; NVO i,iii,xii; SB i,vi; SIN xii (ADW); TEP ix (AMNH); VC xi (MZFC); Zapata, 3 mi SE viii (AME).

Cabares potrillo potrillo (Lucas 1857), J C M. BUC xii; EGUM xii; JUM i; LBA i,vi; Las Piedras x (ADW); LSMO viii (AME); RLNO ix; SB vi; SIN xii (ADW); TEP ix (AMNH).

Ocyba calathana calanus (Godm. & Salv. 1894), J C M. LBA i (ADW); NAY ix (AMNH).

Celaenorrhinus fritzgaertneri (Bailey 1880), J C M. COM, vic. i,x (CUIC); EGUM i,xii; EREF x (ADW); LYB ix (MZFC); MEC x (ADW); Mirador del Aguila ix (MZFC); NAY vi (Hoffmann 1941: AMNH); PAL viii (MZFC).

Celaenorrhinus stola Evans 1952, J C M. EGUM xii; LBA i (ADW); LYB x (MZFC); MEC x (ADW); PAL xi (MZFC).

Spathilepia clonius (Cr. 1775), J C M. COM, vic. x (CUIC); EGUM i (ADW); El Palillo vi (MZFC); EREF x,xii; JUM ix,xii; LBA i (ADW), vi (MZFC); LSMO ix (ADW); LYB ix (MZFC); MEC i,vi,x,xii (ADW); NAY (Hoffmann 1941); SIN xii (ADW).

Cogia hippalus hippalus (W. H. Edw. 1882), J C M. JUM ix (ADW).

Cogia calchas (Herr.-Sch. 1869), J C M. COM, vic. vii (CUIC); EREF x (ADW); Francisco I. Madero viii (AME); Jasmine, 3.5 mi W on Hwy 15 vii (RES); JUM i,ix; MEC x; NVO i; SB vi (ADW); Zapata, 3 mi SE viii (AME).

Telemiades choricus (Schaus 1902), J. SIN xii (ADW).

Telemiades fides Bell 1949, J. JUM i; LBA i; SIN xii (ADW).

Polyctor cleta Evans 1953, J C M. LBA i; SIN xii (ADW).

Nisoniades rubescens (Möschler 1877), J C M. BUC xii; EGUM xii; EREF x,xii; JUM i,ix,xii; LBA i; MEC i,x,xii; NVO i (ADW); SB, 14 mi E ix (AMNH); SIN xii (ADW).

Pachyneuria licisca (Plötz 1882), J M. EGUM i; MEC i,vi,x,xii; SB vi; SIN xii (ADW).

Pellicia arina Evans 1953, J C M. EREF xii; JUM ix,xii; LBA i; LSMO ix; MEC x,xii; NVO i; SIN xii (ADW).
Pellicia dimidiata Herr.-Sch. 1870, J C M. EREF x; JUM ix,xii; LBA vi; MEC i,x,xii; SIN xii (ADW).
Noctuana lactifera bipuncta (Plötz 1884), as *N. noctua bipuncta* in Vargas et al. (1996), J M. COM, vic. x (CUIC). See Austin & Warren (2002) for taxonomic change.
Bolla subapicatus (Schaus 1902), J C M. EGUM x; EREF x; LSMO ix (ADW), viii (AME).
Bolla orsines (Godm. & Salv. 1896), J C M. NAY viii (AMNH).
Bolla evippe (Godm. & Salv. 1896), J C M. EGUM x (ADW).
Bolla eusebius (Plötz 1884), J C M. EREF x; JUM ix; LBA i (ADW); LSMO viii (AME).
Bolla clytius (Godm. & Salv. 1897), J C M. Islas Tres Marías [Type Locality] (BMNH).
Bolla litus (Dyar 1912), J C M. LSMO viii (AME).
Staphylus tierra Evans 1953, J C M. COM, vic. vii (AMNH); COM, 3 mi N viii (AME); EGUM x; EREF x,xii; JUM ix,xii; LBA i,vi; LSMO ix (ADW), viii (AME); LYB ix (MZFC); MEC i,x,xii (ADW); PAL viii (MZFC); Playas Novillero xi (AMNH); RLNO ix; SIN i,xii (ADW); TEP (BMNH), ix (AMNH); TEP, 2.5 mi NW viii (AME).
Staphylus azteca (Scudder 1872), J C M. BUC iii; EGUM i; LBA i (ADW); SB ix (AMNH); TEP (BMNH).
Staphylus iguala (Williams & Bell 1940), J C M. LSMO viii (AME), NAY vii (AMNH).
Gorgythion begga pyralina (Möschler 1877), J C M. BUC xii (ADW); COM, 3 mi N viii (AME); EGUM i,x,xii; EREF x; JUM i,ix,xii; LBA i,vi (ADW), iv (MZFC); Las Piedras x; LSMO ix; MEC i,vi,x,xii; SIN i,vi,xii (ADW); Zapata, 3 mi SE viii (AME).
Zera hyacinthinus (Mab. 1877), J C M. LBA i,vi; SIN xii (ADW); "Sierra Madre Occidental" [in Godman & Salvin (1879-1901) as *Pythonides pelopea* Godm. & Salv. 1894; as *Quadrus pelopea* in Hoffmann (1941); as *Z. tetrastigma* (Sepp 1848) in Freeman (1966)].
Quadrus cerialis (Stoll 1782), J C M. MEC x (MZFC), xii (ADW).
Quadrus lugubris (R. Feld. 1869), J C M. JUM xii; LBA i; SIN xii (ADW).
Sostrata nordica Evans 1953, J C M. LBA i; MEC xii; SIN xii (ADW).
Paches polla (Mab. 1888), J C M. EGUM i,x,xii (ADW); MEC x (ADW, MZFC).
Atarnes sallei (C. Feld. & R. Feld. 1867), J C M. EGUM i,xii; JUM i,xii (ADW), ix (MZFC); LBA i; LSMO ix (ADW), viii (AME); LYB ix (MZFC); MEC i,xii (ADW), x (MZFC); SIN xii (ADW).
Mylon lassia (Hewit. 1868), J C M. MEC x (ADW); PAL iii,xii (MZFC).
Mylon maimon (Fabr. 1775), as *M. menippus* (Fabr. 1777) in Vargas et al. (1996), J M. EGUM x; EREF x; JUM i,xii; LBA i; MEC i,xii; SIN xii (ADW); Zapata, 3 mi SE viii (AME). See Mielke & Casagrande (2002) for taxonomic change.
Mylon pelopidas (Fabr. 1793), J C M. BUC, 7 mi N viii (RES); JUM i,ix,xii; MEC x (ADW); SB vii (HAF); SIN ix (MZFC), xii (ADW); TEP ix (AMNH).
Carrhenes fuscescens (Mab. 1891), J C M. EGUM x; JUM ix; LBA vi (ADW); SB, 4 mi E vii; SB, 14 mi E ix (AMNH); SIN vi (ADW).
Carrhenes canescens canescens (R. Feld. 1869), J C M. LBA ix; LYB ix (MZFC); NAY viii (AMNH); PAL iii,xii (MZFC); SB vii (HAF).
Zobera marginata H. A. Freeman 1979. TEP, 18 mi N viii (Freeman 1979: AMNH).
Clito aberrans (Draudt, 1924), as *C. clito* (Fabr. 1787) in Vargas et al. (1996), J M. COM, vic. xi (CUIC). See Mielke & Casagrande (2002) for taxonomic change.
Xenophanes tryxus (Stoll 1780), J C M. Aticama xii; BUC xii; EGUM i; EREF x; JUM i; LBA i; MEC x (ADW); PAL iii (MZFC); SB vii (HAF); SIN xii (ADW); VC iii (MZFC).
Antigonus nearchus (Latr. [1817]), J C M. Cruz de Juanacaxtle (De la Maza 1987); JUM i,xii; LBA i; MEC i,x,xii (ADW); NAY ix (AMNH); SB i; SIN vi,xii (ADW), iv,ix (MZFC).
Antigonus erosus (Hübner [1812]), J C M. EGUM x; EREF x; JUM i,ix,xii (ADW), iii,x (MZFC); LBA i (ADW), iii,vi (MZFC); Las Piedras x; LSMO ix (ADW), viii (AME); MEC i,x,xii (ADW), ix (MZFC); NAY viii (AMNH); Paso de Mesillas (km 54, Hwy 200) x (ADW); PAL iii (MZFC); SB i (ADW); SB, 4.5 mi E viii (AME); SIN ix (MZFC), vi,xii (ADW); TEP ix; TEP, 2.5 mi NW viii; Zapata, 3 mi SE viii (AME).
Antigonus emorsa (R. Feld. 1869), J C M. COM, 3 mi N viii; Francisco I. Madero viii (AME); JUM ix (ADW); LSMO viii (AME); MEC x (ADW).
Antigonus funebris (R. Feld. 1869), J C M. JUM ix; LSMO ix (ADW), viii (AME); MEC vi (ADW).
Systasea pulverulenta (R. Feld. 1869), J C M. EREF x (ADW); LSMO viii (AME).
Zopyrion sandace Godm. & Salv. 1896, J C M. COM v (CUIC); EGUM i,x,xii; EREF x; JUM i,ix; LBA i,vi (ADW), vi,ix (MZFC); Las Piedras x; LSMO ix (ADW), viii (AME); LYB x (MZFC); MEC i,vi,x,xii; Paso de Mesillas (km 54, Hwy 200) x (ADW); Playas Novillero vi (AMNH); SB, 4.5 mi E viii (AME); SIN ix (MZFC), xii (ADW).
Achlyodes busirus heros Ehrm. 1909, J C M. BUC xii (ADW); COM, vic. viii (AMNH); EGUM x,xii; JUM i,ix,xii; LBA i; MEC i,x,xii; SIN xii (ADW).
Achlyodes pallida (R. Feld., 1869), as *A. selva* Evans 1953 in Warren et al. (1998), J C M. NAY vi (AMNH). See Austin & Warren (2002) for taxonomic change.
Eantis tamenund (W. H. Edw. 1871), J C M. JUM ix; LBA i; LSMO ix (ADW), viii (AME); MEC i,x (ADW); TEP, 2.5 mi NW viii (AME).
Grais stigmaticus stigmaticus (Mab. 1883), J C M. SB ix (MZFC).
Timochares trifasciata trifasciata (Hewit. 1868), J C M. JUM xii; MEC x (ADW); NAY viii (Hoffmann 1941: AMNH); SB (Godman & Salvin 1879-1901); SB, 4.5 mi E viii (AME); SIN xii (ADW); TEP (Godman & Salvin 1897-1901).
Timochares ruptifasciatus (Plötz 1884), J C M. JUM xii; MEC x; RLNO ix (ADW).
Anastrus sempiternus sempiternus (Butl. & H. Druce 1872), J C M. COM, 3 mi N viii (AME); EREF x; LBA i; MEC i,x,xii (ADW); NAY viii (AMNH); PAL iii (MZFC); SIN xii (ADW).
Anastrus luctuosus (Godm. & Salv. 1894), as *A. robigus* (Plötz 1884) in Warren et al. (1998), J C M. EGUM xii (ADW); SB vii (HAF); SIN xii (ADW). See Austin & Warren (2002) for taxonomic change.
Ebrietas anacreon (Staud. 1876), J C M. EREF x; LSMO ix; MEC x,xii (ADW); NAY (Hoffmann 1941); SIN xii (ADW); TEP (Godman & Salvin 1879-1901).
Cycloglypha thrasibulus (Fabr. 1793), J C M. JUM i,ix (ADW); LBA vi (ADW); NAY iv,vii (AMNH); SIN xii (ADW); VC iii (MZFC); Zapata, 3 mi SE viii (AME).
Chiomara georgina georgina (Reak. 1868), J C M. JUM xii; LBA i (ADW); LSMO viii (AME); Playas Novillero vi (AMNH); RLNO xii (ADW); SB v (BMNH), vii (HAF); TEP, 2.5 mi NW viii (AME).
Chiomara mithrax (Möschler 1879), J C M. BUC, 7 mi N viii (RES); COM, 3 mi N viii (AME); EREF x; JUM xii; MEC x, xii (ADW); NAY ix (AMNH).
Gesta invisus (Butl. & Druce 1872), J C M. BUC xii (ADW); COM, vic. iv,vi,vii (AMNH); El Palillo vi (MZFC); EREF xii; JUM ix; MEC x (ADW), i (MZFC); NAY iii (AMNH); NVO iii,xii; RLNO ix,xii (ADW); SB (BMNH).
Erynnis juvenalis clitus (W. H. Edw. 1883), J C. RLNO ix (ADW).
Erynnis tristis tatius (W. H. Edw. 1883), J C M. COM, vic. viii (AMNH); Jasmine, 3.5 mi W on Hwy 15 vii (RES); RLNO ix (ADW).
Erynnis funeralis (Scudder & Burgess 1870), J C M. COM, 3 mi N viii (AME); Jasmine, 3.5 mi W on Hwy 15 vii (RES); JUM i; LSMO ix; NVO iii; RLNO i,ix,xii (ADW); SB vii (HAF); TEP ix; Zapata, 3 mi SE viii (AME).
Pyrgus albescens Plötz 1884, J C M. LSMO viii (AME); TEP ix (ADW).
Pyrgus philetas W. H. Edw. 1881, J C M. LSMO viii (AME); SB vii (HAF).

Pyrgus oileus (L. 1767), J C M. Aticama xii; BUC i,iii,xii (ADW); COM x (CUIC); COM, vic. viii (AMNH); EGUM i,x,xii; EREF x,xii; JUM i,ix,xii (ADW), iv,x,xi (MZFC); LBA i,vi (ADW), vi,ix (MZFC); Las Piedras x; LSMO ix (ADW), viii (AME); LYB vi,ix,x (MZFC); MEC i,vi,x,xii (ADW), ix (MZFC); Paso de Mesillas (km 54, Hwy 200) x (ADW); Mirador del Aguila ix (MZFC); NAY vi,vii (AMNH); PAL viii (MZFC); Playas Novillero xi (AMNH); RLNO i,ix,xii (ADW); SB (BMNH), i,vi (ADW), ix,xii (MZFC); San Francisco xii; SIN vi,xii (ADW), ix (MZFC); TEP (BMNH), ix (ADW, AME, AMNH); TEP, 2.5 mi NW viii (AME); VC iii,vi,vii,x (MZFC); Zapata, 3 mi SE viii (AME).

Heliopyrgus domicella domicella (Erichson [1849]), as *Heliopetes d. domicella* in Warren et al. (1998), J C M. Playas Novillero vi (AMNH). See Austin & Warren (2001) for taxonomic change.

Heliopetes macaira (Reak. [1867]), J C M. Aticama xii (ADW); COM, 3 mi N viii (AME); El Palillo vi (MZFC); EREF x,xii; JUM ix,xii; LBA i,vi; Las Piedras x; LSMO ix (ADW), viii (AME); LYB ix (MZFC); MEC vi,x,xii (ADW); NAY ix (AMNH); NVO i,iii,xii; SB (BMNH), i,vi (ADW), vii (HAF); SB, 4.5 mi E viii (AME); SIN ix (MZFC), xii (ADW); TEP ix (AME); VC x,xi (MZFC); Zapata, 3 mi SE viii (AME).

Heliopetes laviana laviana (Hewit. 1868), J C M. JUM ix (ADW); NVO ix (AME); RLNO i (ADW); SB, 4.5 mi E viii (AME); SIN i (MZFC).

Heliopetes arsalte (L. 1758), J C M. JUM i,xii; LBA i; MEC i,xii (ADW), ix (MZFC); NVO i,iii,xii (ADW); SB (Godman & Salvin 1879-1901), vi (ADW), vii (HAF), ix (MZFC); SIN vi,xii (ADW).

Heliopetes alana (Reak. 1868), J C M. COM, vic. vii-ix (AMNH, CUIC); EREF x,xii; LBA i (ADW), vi,ix (MZFC); LYB vi,x (MZFC); NAY vi-viii (AMNH); PAL viii,x (MZFC); RLNO ix (ADW); SB vii (HAF); SIN xii (ADW); VC iii (MZFC).

Piruna penaea (Dyar 1918), J C M. COM, vic. ix (AMNH).

Dardarina dardaris (Hewit. 1877), J C M. LSMO ix (ADW).

Synapte pecta Evans 1955, C M. NVO ix (AME).

Synapte syraces (Godm. 1901), J C M. COM, vic. viii (AMNH); EREF x; JUM ix; LBA i; RLNO ix (ADW); TEP ix (AMNH).

Synapte shiva Evans 1955, J C M. Francisco I. Madero viii (AME); JUM ix (ADW); LSMO viii (AME); TEP ix (AMNH); Zapata, 3 mi SE viii (AME).

Synapte silna Evans 1955. EREF x (ADW).

Zariaspes mythecus Godm. 1900, J C M. EGUM x; MEC i,x (ADW); Playas Novillero xii (AMNH); SIN xii (ADW).

Anthoptus insignis (Plötz 1882), J C M. LBA i; MEC xii; SIN xii (ADW).

Corticea corticea (Plötz 1883), J C M. EGUM x; EREF x; JUM i,ix (ADW); LYB ix (MZFC); NVO i (ADW); Playas Novillero xii (AMNH); SIN xii (ADW); TEP ix (AMNH, ADW).

Callimormus saturnus (Herr.-Sch. 1869), J C M. BUC i,xii; EGUM x,xii; EREF x; JUM i,ix,xii; Las Piedras x; LBA vi (ADW); LSMO viii (AME); MEC x,xii (ADW); NAY (Hoffmann 1941, as C. corades (C. Feld. 1862)); Paso de Mesillas (km 54, Hwy 200) x; NVO i (ADW); Playas Novillero xi (AMNH); SB (BMNH); SIN xii (ADW); TEP ix (AMNH); VC vii (MZFC).

Mnasicles hicetaon Godm. 1901, C. JUM i; LBA i; SIN xii (ADW).

Methionopsis ina (Plötz 1882), J C M. EGUM i,x,xii; EREF x (ADW); LBA i,vi (ADW), ix (MZFC); Las Piedras x; MEC x,xii; SB i; SIN xii (ADW).

Repens florus (Godm. 1900), J C M. LSMO ix (ADW); TEP (BMNH)[Type Locality]; Sierra Madre Occidental (Hoffmann 1941); Xalisco viii (AMNH).

Phanes aletes (Geyer 1832), J C M. JUM ix; SIN xii (ADW).

Vidius perigenes (Godm. 1900), J C M. Aticama xii (ADW); NAY (Hoffmann 1941).

Monca crispinus (Plötz 1882), as *M. tyrtaeus* (Plötz 1883) in Warren et al. (1998), J C. MEC xii (ADW). See Mielke & Casagrande (2002) for taxonomic change.

Nastra julia (H. A. Freeman 1945), J C M. COM, 3 mi N viii (AME).

Cymaenes trebius (Mab. 1891), J C M. COM, 3 mi N viii (AME); EGUM xii; EREF x,xii; JUM ix,xii; MEC x,xii (ADW); NAY (Hoffmann 1941, as *Lerodea edata* (Plötz 1883)); Playas Novillero xii (AMNH); RLNO ix; SIN xii (ADW); TEP ix; TEP, 18 mi N viii (AMNH); TEP, 2.5 mi NW viii; TEP, 22 mi NNW on Hwy 15 (at Jct Hwy 54) viii; Zapata, 3 mi SE viii (AME).

Vehilius inca (Scudder 1872), J C M. COM, 3 mi N viii (AME); EREF xii; JUM ix; LBA i,vi; LSMO ix; MEC i,x (ADW); PAL iii (MZFC); RLNO ix; TEP ix (ADW); Zapata, 3 mi SE viii (AME).

Vehilius illudens (Mab. 1891), J C M. Valle de Banderas, nr. viii (ADW).

Mnasilus allubita (Butl. 1877), J C M. JUM i,ix; MEC I (ADW); NAY (Hoffmann 1941, as *M. penicillatus* Godm. & Salv. 1900); SIN vi,xii (ADW).

Mnasitheus nitra Evans 1955, J. LBA i; San Francisco xii (ADW).

Remella remus (Fabr. 1798), J C M. EGUM i,x,xii (ADW); Jalcocotán vii (CIB); JUM i; LBA i,vi; MEC i,x; RLNO ix; SIN xii (ADW).

Remella rita (Evans 1955), J C M. COM, vic. iv (AMNH); RLNO i; VC vii,xi (MZFC).

Parphorus sp. Zapata, 3 mi SE viii (AME). Possibly an undescribed species.

Lerema accius (J. E. Smith 1797), J C M. BUC xii (ADW); COM, 3 mi N viii (AME); JUM i,ix,xii; LBA i; LSMO ix (ADW); MEC i,xii; NVO i,xii; RLNO i,ix,xii; SB i; SIN xii (ADW); TEP ix (AMNH); VC iii (MZFC); Zapata, 3 mi SE viii (AME).

Lerema liris Evans 1955, J C M. JUM ix (ADW); LSMO viii (AME); LYB ix (MZFC); MEC x (ADW); Playas Novillero xi; TEP ix (AMNH); TEP, 2.5 mi NW viii (AME).

Morys valda Evans 1955, J C M. LBA i; MEC xii; SIN xii (ADW).

Tigasis simplex (Bell 1930), J. COM, 3 mi N viii; Zapata, 3 mi SE viii (AME).

Vettius fantasos (Cr. 1780), J C M. JUM ix; LBA i; MEC x, xii; SIN xii (ADW).

Thoon modius (Mab. 1889). MEC x,xii (ADW).

Naevolus orius (Mab. 1883). MEC vi (ADW).

Argon argus (Möschler 1879), M. JUM ix (ADW).

Tromba xanthura (Godm. 1901), C M. MEC x (ADW).

Carystus phorcus (Cr. 1777), J. JUM x (MZFC).

Perichares philetes adela (Hewit. 1867), J C M. EREF xii; MEC x; NVO xii; SB xii; SIN xii; TEP ix (ADW).

Lycas argentea (Hewit. 1866), J C. NVO xii (ADW).

Joanna joanna Evans 1955, J. MEC i; SB vi; SIN xii (ADW); TEP, 22 mi NNW, on Hwy 15 (at Jct Hwy 54) viii (AME).

Quinta cannae (Herr.-Sch. 1869), J C M. EREF x; LBA i; SIN xii (ADW).

Mucia zygia (Plötz 1886), J M. BUC xii; JUM ix; MEC x (ADW).

Conga chydaea (Butl. 1877), J C M. COM, 3 mi N viii (AME); JUM ix; LBA i (ADW); LSMO viii (AME); MEC i (ADW); Zapata, 3 mi SE viii (AME).

Ancyloxypha arene (W. H. Edw. 1871), J C M. EREF x,xii (ADW); Francisco I. Madero viii (AME); JUM i,ix; LSMO ix (ADW); Playas Novillero xi,xii (AMNH); RLNO i,ix (ADW); TEP (BMNH).

Copaeodes minima (W. H. Edw. 1870), J C M. EREF xii; JUM ix (ADW); LYB x (MZFC); RLNO i,ix,xii; SB vi (ADW); TEP ix; TEP, 2.5 mi NW viii (AME).

Hylephila phyleus phyleus (Drury 1773), J C M. BUC i,iii,xii (ADW); COM, 3 mi N viii (AME); JUM ix; LBA i (ADW); NVO i,iii,xii (ADW); Playas Novillero xi (AMNH); RLNO ix (ADW); SB ix,xii (MZFC), vii (HAF); SIN xii (ADW); TEP (Godman & Salvin 1879-1901), ix (AMNH); VC xi (MZFC).

Polites subreticulata (Plötz 1883), J C M. COM, 3 mi N viii (AME).

Polites vibex praeceps (Scudder 1872), J C M. BUC xii (ADW); COM, 3 mi N viii (AME); Jasmine, 3.5 mi W on Hwy 15 vii (RES); LBA i; LSMO ix; NVO i,xii (ADW); PAL i (MZFC); Playas Novillero xii (AMNH); SB vi (ADW); TEP, 2.5 mi NW viii; Zapata, 3 mi SE viii (AME).

Wallengrenia otho otho (J. E. Smith 1797), J C M. JUM i,ix; LBA i; LSMO ix; MEC i,x (ADW).

Pompeius pompeius (Latr. [1824]), J C M. BUC i,iii,xii (ADW); COM, 3 mi N viii (AME); EGUM x,xii; EREF x,xii; JUM ix,xii; LBA i; Las Piedras x (ADW); LSMO viii (AME), ix (ADW); MEC xii; NVO i,iii,xii; SB vi (ADW); TEP (BMNH), ix (AME).

Pompeius dares (Plötz 1883), M. JUM i (ADW).
Poanes zabulon (Boisd. & LeC. [1837]), J C M. RLNO i,ix (ADW); VC xi (MZFC).
Poanes inimica (Butl. & Druce 1872), J C M. Zapata, 3 mi SE viii (AME).
Quasimellana mexicana (Bell 1942). NAY ix (AMNH).
Quasimellana eulogius (Plötz 1883), J C M. COM, 3 mi N viii (AME); JUM ix; LSMO ix (ADW); TEP ix (AMNH).
Quasimellana agnesae (Bell 1959), J C. NVO i,xii (ADW). See Warren (2000) for notes on this species.
Quasimellana mulleri (Bell 1942), J C M. Zapata, 3 mi SE viii (AME).
Quasimellana nayana (Bell 1941). Zapata, 3 mi SE viii (AME).
Quasimellana myron (Godm. 1900), J M. Zapata, 3 mi SE viii (AME).
Euphyes peneia (Godm. 1900), J M. JUM ix (ADW); SB, 4 mi E vii (AMNH).
Euphyes canda Steinhauser & A. Warren 2002, M. MEC vi (Steinhauser & Warren 2002).
Metron chrysogastra (Butl. 1870), J. VC iii (MZFC).
Amblyscirtes folia Godm. 1900, J C M. COM, 5 mi N viii (USNM); Zapata, 3 mi SE viii (AME).
Amblyscirtes raphaeli H. A. Freeman 1973, C M. LBA vi (MZFC).
Amblyscirtes brocki H. A. Freeman 1992. Zapata, 3 mi SE viii (AME).
Amblyscirtes tolteca tolteca Scudder 1872, J C M. COM, 3 mi N viii (AME); COM, 5 mi SW viii (Freeman 1993); JUM ix (ADW); LSMO viii (AME); LYB ix (MZFC); MEC vi (ADW); TEP ix (AMNH); TEP, 22 mi NNW on Hwy 15 (at Jct Hwy 54) viii; Zapata, 3 mi SE viii (AME).
Amblyscirtes novimmaculatus A. Warren 1998, J M. RLNO ix (Warren 1998; ADW).
Lerodea eufala (W. H. Edw. 1869), J C M. JUM i (ADW); LSMO viii (AME); SIN xii (ADW).
Lerodea arabus (W. H. Edw. 1882), J C M. NVO i (ADW).
Calpodes ethlius (Stoll 1782), J C M. COM, vic. v (CUIC); LYB ix; SB ix; VC x (MZFC).
Panoquina errans (Skinner 1892), J C. BUC i; NVO i (ADW).
Panoquina ocola (W. H. Edw. 1863), J C M. JUM i,xii; LBA i; MEC i,x (ADW); NAY (Hoffmann 1941); SIN xii (ADW).
Panoquina hecebolus (Scudder 1872), J C M. BUC, 7 mi N viii (RES); COM, 3 mi N viii (AME); LBA i (ADW); TEP ix (AMNH); Zapata, 3 mi SE viii (AME).
Panoquina lucas (Fabr. 1793), as *P. sylvicola* (Herr.-Sch. 1865) in Vargas et al. (1996), J C M. EREF x; JUM ix; LBA i; MEC i,x; NVO i (ADW). See Robbins et al. (1996) for taxonomic change; misspelled as *leucas* in Warren et al. (1998) and Warren (2000).
Panoquina evansi (H. A. Freeman 1946), J C M. BUC xii; JUM i,xii; LBA i; NVO i,xii; SB i (ADW).
Zenis janka Evans 1955, J. Cruz de Juanacaxtle (De la Maza 1987); SIN xii (ADW).
Nyctelius nyctelius nyctelius (Latr. [1824]), J C M. JUM ix; LBA i; SB vi (ADW).
Thespieus dalman (Latr. [1824]), J C M. NAY x (AMNH); VC xi (MZFC).
Vacerra litana (Hewit. 1866), J C M. JUM ix; MEC i (ADW).
Vacerra gayra (Dyar 1918), J C M. NAY ix (AMNH).
Vacerra "lachares" Godm. 1900, J. COM, vic. x (CUIC); LBA i; MEC vi (ADW). See Vargas et al. (1996) for taxonomic comments.
Niconiades incomptus Austin 1997, as *N. xanthaphes* Hübner, [1821] in Vargas et al. (1996), J C M. EGUM xii; SIN xii (ADW).
Aides dysoni Godm. 1900, J C M. Aticama xii; Paso de Mesillas (km 54, Hwy 200) x (ADW); Rincón de Guayabitos ix (MZFC); SB, 4.5 mi E viii (AME).
Saliana fusta Evans 1955, J M. COM x (CUIC); LBA i; NVO xii (ADW).
Saliana esperi esperi Evans 1955, J C. LBA i; MEC xii; Paso de Mesillas (km 54, Hwy 200) x (ADW).
Saliana longirostris (Sepp 1840), J C. PAL xi; Punta de Mita iv (MZFC).
Thracides phidon (Cr. 1779), J C M. LYB xi (MZFC).
Stallingsia sp. NAY (K. Roever, pers. comm.). Apparently an undescribed species.
Agathymus rethon (Dyar 1913), J C M. El Pantanal vi (AMNH).

PAPILIONIDAE (24 SPECIES)

Battus philenor philenor (L. 1771), J C M. Amatlán (AMNH); JUM ix; LYB iii,vi (MZFC); TEP (AMNH).
Battus philenor orsua (Godm. & Salv. 1889), C. Islas Tres Marías (Godman & Salvin 1879 1901, Hoffmann 1940, Beutelspacher 1984); xi, xii (AMNH).
Battus polydamas polydamas (L. 1758), J C M. Bahía de Banderas (AMNH); BUC xii (ADW); Chacala x (MZFC); EGUM xii (ADW); El Palillo vi (MZFC); EREF x (ADW); Huajicori vii; Huajicori, 2 mi N vii,viii; Huajicori, 6 mi N vii (SDNHM); Hwy 200, 33 km N Puerto Vallarta iii,v (LACM); Islas Tres Marías (Godman & Salvin 1879 1901); JUM i,ix,xii (ADW), vii,ix xi (MZFC); LBA i (ADW), ix (MZFC); La Colonia (Beutelspacher 1984); La Peñita xii (MZFC); Las Piedras x (ADW); MEC ix (MZFC), i,x,xii (ADW); Navarelte x (LACM); NVO xii (ADW); PAL iii,x (MZFC); SB (Godman & Salvin 1879 1901), vii (ADW), viii (AME), xi (LACM), iii,ix,xi,xii (MZFC); SB, 20 mi E vi (LACM); SB, 3 mi S viii (CAS); San Ignacio, 4 km S on Hwy 200 ii (LACM); San Quintín ix (MZFC); SIN iv,vii,ix,xii (MZFC), vi,xii (ADW); TEP ix (AME).
Battus laodamas iopas (Godm. & Salv. 1897), J C M. Bahía de Banderas; COM viii (AMNH), viii (CUIC); El Palillo vi (MZFC); EREF x (ADW); Huajicori viii (SDNHM); JUM ix,x (ADW), ix xi; LBA ix; LYB viii,ix (MZFC); LSMO ix (ADW); MEC vii,ix (MZFC), x (ADW); RLNO ix (ADW); SB (Godman & Salvin 1879 1901), vii,viii (AME), ix (MZFC), viii,x (LACM); San Quintín ix; SIN iii,v,ix (MZFC); TEP viii (CAS).
Parides alopius (Godm. & Salv. 1890), J M. Jalisco viii, ix (AMNH); TEP, E of xii (LACM).
Parides photinus (Doubleday 1844), J C M. Ahuacatlán (Beutelspacher 1984); Aticama xii (ADW); COM viii x (AMNH); EGUM i,xii; EREF x; JUM i,ix,xii (ADW), ix,xii (MZFC); LBA i (ADW), ix (MZFC); LYB ix,xi (MZFC); MEC i,x,xii (ADW); PAL xii (MZFC); Paso de Mesillas (km 54, Hwy 200) x (ADW); Peñita de Jaltemba xii (MZFC); SB xii (MZFC), vii (AME); San Francisco xii (ADW); Santiago Ixquintla xii (LACM); SIN (De la Maza 1987), ix,xii (MZFC), vi,xii (ADW); VC iii,iv,xi,xii (MZFC).
Parides montezuma (Westw. 1842), J C M. Aticama xii (ADW); Bahía de Banderas xi (AMNH); Cerro San Juan (Boullet & Le Cerf 1912); Chacala x (MZFC); COM viii,x (CUIC); EGUM x,xii (ADW) El Mamey, MEC vi; El Palillo iii (MZFC); EREF x,xii (ADW); Los Cocos - Matanchén v (MZFC); Huajicori vii; Huajicori, 2 mi N vii,viii; Huajicori, 4 mi N vii; Huajicori, 6 mi N vii (SDNHM); JUM iii,vii x (MZFC), i,ix,xii (ADW); LBA vi (ADW), vi,ix,x; LBA, 4 km E vi; LYB v,vi viii,ix xii; MEC ix (MZFC), i,vi,x,xii (ADW); Miramar Jalcocotán xii (LACM); PAL iii,x xii; Pintadeño vi,x (MZFC); SB (De la Maza 1987; Godman & Salvin 1879 1901), vi (CAS), viii (AME), x (LACM); SB, 16 mi E viii (CAS); SB, Hwy 46 xi (LACM); San Quintín ix (MZFC); SIN iii,ix (MZFC), vi,xii (ADW); TEP viii (CAS).
Parides erithalion trichopus (Rothschild & Jordan 1906), J C M. Chacala x (MZFC); COM v,vii (CUIC), viii (AMNH); EGUM xii; EREF x; JUM i,ix,xii (ADW), xi; LBA ix (MZFC), vi (ADW); LBA, 4 km E vi; LYB iv vi,ix xi; MEC iii (MZFC), i,x,xii (ADW); PAL x xii; Pintadeño x; San Quintín ix (MZFC); Sayulita, 2 mi N xi (CAS); SIN xii (ADW); TEP (De la Maza 1980), viii (CAS); TEP, E of xii (LACM); VC iii,iv,vi,viii,x,xii (MZFC), viii (De la Maza 1980).
Parides eurimedes mylotes (H.W. Bates 1861), C. TEP vi,vii (CAS). It is possible that these specimens are mis-labeled, or that the specimens are strays; the absence of other records from the state is curious.
Protographium epidaus tepicus (Rothschild & Jordan 1906), J C M. Ahuacatlán vii (UCB); El Mamey, MEC vi; El Palillo v,vi (MZFC); Jesús María vii (UCB); JUM vi viii (MZFC); LYB ix (MZFC); Pantanal; Playas Novillero, Tecuala (AMNH); SB (Beutelspacher 1984, Godman & Salvin 1879 1901, CMNH), vii

(ADW), viii (LACM); SIN v,vii (MZFC); TEP (AMNH); TEP, 25 mi N vi (CAS).

Protographium philolaus philolaus (Boisd. 1836), J C M. Camalote vi (MZFC); COM (AMNH); El Palillo vi,xi (MZFC); Jesús María vii (UCB); JUM vii,viii; LBA vi (MZFC); Playas Novillero, Tecuala vi (AMNH); SB (De la Maza 1987), vii (ADW); SB, 7 mi E vii (SDNHM); SIN vii (MZFC); Tecuala, COM vii (CAS); TEP (Beutelspacher 1984); TEP, 25 mi N vi (CAS); VC vi,viii (MZFC).

Protographium agesilaus fortis (Rothschild & Jordan 1906), J C M. Camalote vi; LBA vi (MZFC); LYB (De la Maza 1987).

Mimoides thymbraeus aconophos (Gray [1853]), J C M. COM x (CUIC); JUM vi (MZFC); Mirador del Aguila ix (MZFC); TEP viii (AMNH); VC vi (MZFC).

Mimoides ilus occiduus (Vázquez 1956), J C M. JUM vii (MZFC); SB vi; TEP vi (CAS).

Heraclides rogeri pharnaces (Doubleday 1846), as *Priamides pharnaces* in Warren et al. (1998), J C M. COM (Beutelspacher 1984); El Izote vi (MZFC); EREF x (ADW); Huajicori, 2 mi N viii; Huajicori, 4 mi N vii (SDNHM); JUM ix (ADW, MZFC); LBA i (ADW), vi; LBA, 4 km E vi; LYB x (MZFC); MEC i,x,xii (ADW), vi (MZFC); NVO i (ADW); PAL x,xii (MZFC); SB ix; SIN ix (MZFC), vi,xii (ADW); TEP (Beutelspacher 1984); VC vi,x xii (MZFC).

Heraclides anchisiades idaeus (Fabr. 1793), as *Priamides a. idaeus* in Warren et al. (1998), J C M. JUM i,ix; MEC x (ADW); SB, Hwy 46 xi (LACM).

Heraclides ornythion ssp., as *Calaides ornythion* ssp. in Warren et al. (1998), J C M. SB vi; SIN vi (ADW). Apparently an undescribed subspecies.

Heraclides astyalus bajaensis (J.W. Brown & Faulkner 1992), listed under *Calaides* in Warren et al. (1998), J C M. El Izote vi (MZFC); Playas Novillero, Tecuala vi (AMNH).

Heraclides androgeus epidaurus (Godm. & Salv. 1890), listed under Calaides in Warren et al. (1998), J C M. El Izote vi (MZFC); El Palillo (De la Maza 1987); LSMO ix (ADW); MEC ix; SIN ix (MZFC).

Heraclides thoas autocles (Rothschild & Jordan 1906), J C M. EGUM x (ADW); El Mamey, MEC vi; El Palillo vi (MZFC); JUM vii x; LBA i (ADW), vi,ix (MZFC); LBA, 4 km E vi; La Libertad, 3 km W iv; La Palma iii; LYB v,ix,x (MZFC); MEC i,x (ADW), iv,vii; PAL x,xii; Pintadeño iv; SB ix (MZFC), vii (ADW); San Quintín ix; SIN vii,ix,xii (MZFC).

Heraclides cresphontes (Cr. 1777), J C M. Bahía de Banderas (AMNH); BUC xii (ADW); COM (Beutelspacher 1984); EREF x (ADW); Jalisco (AMNH); Jesús María vii (MZFC); JUM iii,vii (MZFC), i; LBA i; LSMO ix; MEC x (ADW); SB viii (MZFC); SIN xii (ADW), ix (MZFC).

Papilio polyxenes asterius Cr. 1782, J C M. COM ; Jalisco (AMNH); LYB x (MZFC); Mirador del Aguila (Beutelspacher 1984); Santa Cruz v (RES); TEP (Beutelspacher 1984); SIN ix (MZFC).

Pterourus pilumnus (Boisd. 1836), C M. Camino Palapita xi; JUM viii,ix,xi (MZFC), ix,xii (ADW); LBA (De la Maza 1987); LYB iii,v,vi (MZFC); MEC i,x (ADW), iii,ix; Mirador del Aguila ix; PAL iii,xi,xii (MZFC); Pantanal (AMNH); Pintadeño vi,x (MZFC); RLNO ix (ADW); SIN ix (MZFC); TEP ix (CAS); VC iii,vi (MZFC).

Pterourus garamas garamas (Geyer [1829]), J C M. El Izote vi (MZFC); EREF x (ADW); LYB vii,ix,x; PAL xii (MZFC); RLNO i,vi,ix (ADW); VC (De la Maza 1987), iii,iv,vi,xi (MZFC).

Pterourus menatius morelius (Rothschild & Jordan 1906), as *P. victorinus morelius* in Warren et al. (1998), J C M. Cerro San Juan (Boullet & Le Cerf 1912); COM, vic. viii (CUIC); El Izote vi; LBA ix; LBA, 4 km E vi; LYB iv vi,viii x (MZFC); MEC x (ADW); Mirador del Aguila ix; PAL x,xi; Tepetilte vi; VC iii,vi,xi (MZFC).

PIERIDAE (37 SPECIES)

Enantia mazai diazi Llorente 1984, J C M. COM (AMNH), viii (AME); COM, vic. viii (CUIC); EREF x,xii (ADW); Jalisco i,vii (MZFC); LBA vi (ADW), iv; LYB v-vii,ix xi (MZFC); ix,x (Vázquez 1989; Llorente 1984: CIB), xi (MZFC); Lo de García v (MZFC); MEC i,xii (ADW); PAL i,iii,vii,xi,xii; Pintadeño vi (MZFC); RLNO ix; SIN xii (ADW); Tepetilte vi; VC iii,iv,vi,xi,xii (MZFC).

Lieinix nemesis nayaritensis Llorente 1984, J M. Jalcocotán Jalisco, Palapita i (Vázquez 1989; Llorente 1984: CIB); VC vi,x (MZFC).

Dismorphia amphione lupita Lamas 1979, as *D. amphiona lupita* in Warren et al. (1998), J C M. COM (AMNH, USNM), ix (CUIC, Lamas 1979: USNM), xi (Lamas 1979: AMNH); EGUM i; JUM i,ix (ADW), iii (MZFC); LBA (De la Maza 1987), i (ADW), iii,ix,xi (MZFC), iv,vi (Lamas 1979); LYB (Lamas 1979: MZFC, De la Maza 1987), v (Lamas 1979: MZFC), v,vi,viii x (MZFC), ix (CMHN, Lamas 1979: MZFC); Lima de Abajo (De la Maza 1987), ii (Lamas 1979); MEC iii (MZFC), xii (ADW); PAL iii, x xii (MZFC); SIN v (MZFC), xii (ADW); VC iv (MZFC).

Colias eurytheme Boisd. 1852, J M. COM vi,vii,xi (AMNH); VC iii (MZFC).

Zerene cesonia cesonia (Stoll 1791), J C M. COM xi (AMNH); COM, 3 mi N viii (AME); EREF x,xii (ADW); Huajicori, 1 mi S vii (SDNHM); Islas Tres Marías xi; Jalisco ix (AMNH); JUM i,ix,xii (ADW), vii xii (MZFC); LYB vi,ix,x (MZFC); LSMO ix; Las Piedras x; MEC xii (ADW); Mirador del Aguila ix (MZFC); NVO i,xii (ADW); PAL x,xi (MZFC); RLNO i,ix,xii (ADW); SB x (LACM); SIN ix (MZFC), xii (ADW); TEP ix (AME); VC x (MZFC); Zapata, 3 mi NE viii (AME).

Anteos clorinde (Godart [1824]), as *A. c. nivifera* (Fruhstorfer 1907) in Warren et al. (1998), J C M. BUC xii (ADW); COM, Jalisco (AMNH); EGUM xii; EREF x; JUM iv,viii,ix (MZFC); xii (ADW); LYB vi,ix,x (MZFC); LSMO ix; MEC ix (MZFC), x,xii; NVO i,xii (ADW); Pintadeño x (MZFC); SB i (CAS), ix; SIN ix (MZFC), xii (ADW); TEP viii (USNM); VC iii,iv,vi,x (MZFC).

Anteos maerula (Fabr. 1775), as *A. m. lacordairei* (Boisd. 1836) in Warren et al. (1998), J C M. Bahía de Banderas xi; COM (AMNH); EGUM xii (ADW); El Palillo iii (MZFC); Hwy 200, 30.5 km N Puerto Vallarta iii (LACM); JUM ix (MZFC), ix,xii; LBA i (ADW), ix; LYB vi,ix (MZFC); LSMO ix (ADW); MEC ix (MZFC), x,xii (ADW); PAL iii (MZFC); Playas Novillero, Tecuala (AMNH); RLNO ix; SIN vii,ix (MZFC), xii (ADW); VC iii,x (MZFC)

Phoebis agarithe agarithe (Boisd. 1836), J C M. Aticama, 2 km N v (MZFC); Bahía de Banderas; COM (AMNH); EGUM i,xii (ADW); EREF xii (ADW); Jalisco (AMNH); JUM xi (MZFC), i,xii; LBA i,vi (ADW); LYB v,x (MZFC); Las Piedras x (ADW); Matanchén ix (MZFC); MEC x,xii (ADW); PAL x (MZFC); Playas Novillero, Tecuala (AMNH); SB i,vi (ADW), x (LACM), iii,ix,xi,xii (MZFC); SIN ix (MZFC), xii (ADW); Tepetilte v (MZFC); TEP (AMNH).

Phoebis argante ssp., as *P. a. argante* (Fabr. 1775) in Warren et al. (1998), J C M. COM (AMNH); EGUM i,xii (ADW); El Mamey, MEC vi; El Palillo vi (MZFC); EREF xii (ADW); Francisco I. Madero viii (AME); JUM iv,vii ix (MZFC), xii; LBA i (ADW), vi,vii; LBA, 4 km E vi; LYB iv,vi,vii,ix,x (MZFC); LSMO ix; MEC i,x,xii (ADW), vi,ix; Mirador del Aguila ix; PAL iii,v,viii,x,xii (MZFC); Playas Novillero, Tecuala (AMNH); SB ix (MZFC), ii (CAS), viii (LACM); SIN vii,ix (MZFC); xii (ADW); VC iii,xii (MZFC). Apparently an undescribed subspecies.

Phoebis neocypris virgo (Butl. 1870), J C M. COM (AMNH); JUM vii (MZFC); MEC x (ADW); PAL iii (MZFC); RLNO i (ADW); VC iii,iv,xii (MZFC).

Phoebis philea philea (L. 1763), J C M. COM (AMNH); EGUM i; EREF x,xii; JUM i,ix,xii (ADW), vii,ix (MZFC); LBA i (ADW); LYB iv,ix (MZFC); Las Piedras x; MEC i,x,xii (ADW), ix; Mirador del Aguila ix (MZFC); NVO xii; RLNO i,ix (ADW); SB i (ADW), x (MZFC, LACM); SIN xii (ADW), ix,xii (MZFC).

Phoebis sennae marcellina (Cr. 1777), J C M. Aticama xii; BUC i,iii,xii (ADW); COM viii (AME); EGUM i,xii (ADW); El Palillo vi (MZFC); EREF x,xii (ADW); Hwy 200, 27 km N Puerto Vallarta iii; Hwy 200, 30.5 km N Puerto Vallarta iii (LACM); Islas Tres Marías (Godman & Salvin 1879 1901), xi; Jalisco (AMNH); Jesús María vii (UCB); JUM iii,iv,vii xi (MZFC), i,ix,xii; LBA i,vi (ADW), vi; LYB ix,x (MZFC); LSMO viii (AME), ix; Las Piedras

x; MEC i,x,xii (ADW), ix; Mirador del Aguila ix (MZFC); Navarelte x (LACM); NVO i,iii,xii (ADW); PAL iii,xi (MZFC); Pantanal; Playas Novillero, Tecuala (AMNH); RLNO i,ix,xii (ADW); SB ix,xi,xii (MZFC), i,vii (ADW), vii (UCB); San Quintín ix (MZFC); Sayulita vi (LACM); SIN vii,ix (MZFC), xii (ADW); Tecuala, COM; TEP (AMNH), viii,ix (AME); TEP, 60 mi N viii (SDNHM); VC iii (MZFC); Zapata viii (AME).

Rhabdodryas trite ssp., as *R. t. trite* (L. 1758) in Warren et al. (1998), J C M. COM (AMNH); El Palillo iii (MZFC); EREF x,xii (ADW); JUM ix (MZFC), i,xii; LBA i,vii (ADW), ix; LYB iv,vi,ix; MEC iv,ix (MZFC), x (ADW); SIN vii,ix (MZFC), xii (ADW). Apparently an undescribed subspecies.

Aphrissa statira jada (Butl. 1870), J C M. BUC i,iii,xii (ADW); Chacala ix (MZFC); COM (AMNH); EGUM xii (ADW); El Palillo iii (MZFC); JUM vii ix (MZFC), i,xii; LBA i (ADW); LYB iv (MZFC); LSMO viii (AME); MEC xii; NVO i,iii,xii (ADW); SB viii (LACM); SIN iv,ix (MZFC), vi,xii (ADW); TEP (AMNH).

Abaeis nicippe (Cr. 1780), J C M. Amatlán (AMNH); BUC xii (ADW); COM (AMNH); JUM viii xi (MZFC); LBA i (ADW), vi (MZFC).

Pyrisitia dina westwoodi (Boisd. 1836), J C M. Amatlán (AMNH), i (CUIC); Aticama xii (ADW); Aticama, 1 km N vi (MZFC); COM (AMNH); EGUM i,x,xii (ADW); Hwy 200, 27 km N Puerto Vallarta iii; Hwy 200, 30.5 km N Puerto Vallarta iii (LACM); JUM xii; LBA i (ADW), vii,ix; LBA, 4 km E vi; LYB ix (MZFC); LSMO ix; MEC i,xii (ADW); Punta de Mita iii (MZFC); SB viii (SDNHM), x (LACM); SIN iv,vi,vii,ix (MZFC), xii (ADW); TEP ix (AME); VC x (MZFC).

Pyrisitia lisa centralis (Herr.-Sch. 1864), J C M. Aticama xii; BUC xii; EREF x,xii; NVO xii; RLNO ix (ADW); SB vi (ADW, CAS, UCB); SIN xii (ADW).

Pyrisitia nise nelphe (R. Feld. 1869), J C M. Aticama, 1 km N vi (MZFC); BUC xii (ADW); COM (AMNH); El Palillo iii (MZFC); EREF x (ADW); Francisco I. Madero viii (AME); Jalisco (AMNH); JUM ix (ADW), ix,x (MZFC); LBA i (ADW), ix; LYB vi,ix,x (MZFC); LSMO viii (AME); Matanchén ix (MZFC); MEC i,x,xii; NVO xii; RLNO ix; SB vi (ADW), ix,xi; SIN xii (ADW); TEP iv,vi (MZFC), x (AME); TEP, E of xii (LACM); VC iii,vi (MZFC).

Pyrisitia proterpia (Fabr. 1775), J C M. COM v (CUIC); COM, 6.5 mi S (AMNH); EGUM x; EREF x,xii (ADW); Francisco I. Madero viii (AME); Islas Tres Marías (AMNH); JUM iv,vii x (MZFC); i,ix,xii (ADW); LBA ix; LYB v,vi,ix,x (MZFC); LSMO ix; Las Piedras x (ADW); MEC ix (MZFC), i,x,xii (ADW); Mirador del Aguila ix; PAL i,x,xii; Pintadeño iv (MZFC); RLNO ix; SB vi (ADW), ix (MZFC), i,vi (CAS), ii,vii (UCB); SIN xii (ADW), vii,ix; Tepetilte v (MZFC); TEP ix (AME); TEP, 60 mi N viii (SDNHM); TEP, E of xii (LACM); VC iii,x,xii (MZFC).

Eurema albula celata (R. Feld. 1869), J C M. EREF x,xii; LBA i,vi (ADW), vi,vii,ix; LYB iv,ix (MZFC); MEC i,xii (ADW); PAL iii,vii,x xii (MZFC); Paso de Mesillas (km 54, Hwy 200) x; RLNO ix (ADW).

Eurema arbela boisduvaliana (C. Feld. & R. Feld. 1865), as *E. boisduvaliana* in Warren et al. (1998), J C M. Amatlán i (CUIC); BUC xii (ADW); COM (De la Maza 1987, AMNH); COM, vic. vii (CUIC); EGUM i,xii (ADW); EREF x,xii (ADW); Islas Tres Marías (Godman & Salvin 1879 1901, AMNH); Jesús María viii (MZFC); JUM i,ix,xii (ADW); viii xi (MZFC); LBA i (ADW); LYB x (MZFC); LSMO ix; MEC i,x,xii; NVO xii (ADW); Playas Novillero, Tecuala (AMNH); San Francisco xii; SIN xii (ADW); TEP ix (AME).

Eurema daira sidonia (R. Feld. 1869), as *E. daira* (Godart, 1819) in Warren et al. (1998), J C M. Acaponeta, 10 mi S xii (LACM); Acaponeta, 3 mi N vii (SDNHM); Amatlán (AMNH); Aticama xii (ADW); Bahía de Banderas (AMNH); BUC i,iii,xii (ADW); "Caponeta" [Acaponeta], 29 mi S i (CAS); COM (AMNH), v (CUIC), viii (AME); COM, 6.5 mi S (AMNH); EGUM i,x,xii (ADW); El Palillo iii,vi (MZFC); EREF x,xii (ADW); Huajicori, 1 mi S vii (SDNHM); Ixtlán del Río, 12 mi SE xii (UCB); Jalisco (AMNH); JUM i,ix,xii (ADW), iii,iv,vii,ix xi; LBA ix (MZFC); i,vi (ADW); LYB iii,v,vi,ix xii (MZFC); LSMO viii (AME), ix (ADW); LSMO, 15 mi SSE xii (UCB); Las Piedras x; MEC i,vi,x,xii (ADW), vii,ix; Mirador del Aguila iii,ix (MZFC); NVO i,iii,xii (ADW); PAL i,iii,vii,x xii; Pintadeño iv,vi,x (MZFC); Playas Novillero, Tecuala (AMNH); RLNO i,vi,ix,xii (ADW); SB i,xii (MZFC), i (ADW, CAS), ii (CAS), vii,xii (UCB), viii (AME, LACM); SB, Hwy 46 i (CAS); SIN vii,ix (MZFC), xii (ADW); Tepetilte v,vi (MZFC); TEP (AMNH, USNM), vi (UCB), viii (AME); TEP, 10.5 mi NW (AMNH); TEP, 17 mi NW xi (CAS); TEP, 5 10 mi N xii (LACM); TEP, 60 mi N viii (SDNHM); TEP, E of xii (LACM); Tuxpan, 15 mi N x (UCB); Venado, 49.4 mi E iii (SDNHM); VC i,iii,iv,vi viii,x,xi (MZFC).

Eurema mexicana mexicana (Boisd. 1836), J C M. Amatlán i (CUIC); COM (AMNH); JUM ix (ADW); LYB (De la Maza 1987), vi,x xii (MZFC); MEC i (ADW); PAL i,x (MZFC); RLNO i,ix,xii (ADW); Tepetilte vi (MZFC); TEP, E of xii (LACM); Zapata, 3 mi SE viii (AME).

Eurema salome jamapa (Reak. 1866), J C M. LYB x,xi (MZFC); MEC xii (ADW); PAL i; Punta de Mita iii (MZFC); RLNO i,xii (ADW); VC vi (MZFC).

Nathalis iole Boisd. 1836, J C M. COM viii; (AME); LYB vi (MZFC); LSMO viii (AME); Tepetilte vi (MZFC); VC vii (MZFC).

Kricogonia lyside (Godart 1819), J C M. Bahía de Banderas xii (AMNH); COM viii (AME); Islas Tres Marías (Godman & Salvin 1879 1901), xi (AMNH); SB vii (USNM).

Hesperocharis costaricensis pasion (Reak. [1867]), J C M. COM i (CUIC); LBA i (ADW); PAL i,iii,xi,xii; VC iii (MZFC).

Catasticta flisa arechiza (Reak. 1866), as *C. f. flisa* (Herr.-Sch. [1853]) in Warren et al. (1998), J C M. COM iv (AME), xii (AMNH); VC (De la Maza 1987), iii,iv (MZFC).

Pereute charops leonilae Llorente 1986, J C. Cañada de Sangangüey vii (Llorente 1985: MZFC); El Izote vi (MZFC); LYB v (Llorente 1985: MZFC), v (MZFC); Pintadeño vi (MZFC); RLNO i,vi,ix (ADW); Tepetilte v (MZFC); VC (Llorente 1985, De la Maza 1987: MZFC), i,iii,vi viii,x xii (MZFC), vi,xii (AME), vi,xii (Llorente 1985: CIB), vi,xii (Vázquez 1989: CIB), vi,xii (Llorente 1985: MZFC), x (Llorente 1985: MZFC).

Melete lycimnia isandra (Boisd. 1836), J C M. Hwy 200, 30.5 km N Puerto Vallarta iii; Hwy 200, 33 km N Puerto Vallarta iii (LACM); LBA i (ADW); LYB vi (MZFC); LSMO xii (CAS); MEC i; NVO i (ADW); SB i; SIN xii (ADW).

Glutophrissa drusilla tenuis (Lamas 1981), J C M. COM xii (AMNH); EGUM i,xii (ADW); Hwy 200, 27 km N Puerto Vallarta iii; Hwy 200, 33 km N Puerto Vallarta iii (LACM); Islas Tres Marías xi (AMNH); JUM i,xii; LBA i; MEC i (ADW), ix (MZFC); NVO i,xii (ADW); PAL xii (MZFC); SB i (ADW), iii (MZFC); SB, Hwy 46 xi (LACM); SIN ix (MZFC), xii (ADW); TEP (Godman & Salvin 1879 1901, AMNH).

Pieris rapae rapae (L. 1758), J M. VC iii (MZFC).

Pontia protodice (Boisd. & LeC. 1829), J C M. TEP ii; VC iii (MZFC).

Leptophobia aripa elodia (Boisd. 1836), J C M. COM (AMNH); EREF xii (ADW); LYB ix,x (MZFC); RLNO i,xii (ADW).

Pieriballia viardi viardi (Boisd. 1836), as *P. v. laogore* (Godm. & Sal. 1889) in Warren et al. (1998), J C M. COM ii,v,viii x,xii (AMNH); EGUM xii (ADW); JUM xii (MZFC); LBA i (ADW), vi,ix,x; LBA, 4 km E vi (MZFC); MEC xii (ADW); PAL xii (MZFC); Paso de Mesillas (km 54, Hwy 200) x (ADW); SB ii (CAS), xii (MZFC, UCB); SIN xii (ADW).

Ascia monuste monuste (L. 1764), J C M. Aticama xii; BUC i,iii,xii (ADW); COM xii (AMNH); EGUM x,xii; EREF x,xii (ADW); Jalisco viii (AMNH); JUM iii,viii,ix (MZFC), xii; LBA i (ADW); LYB iii,ix xi (MZFC); Las Piedras x; MEC x,xii (ADW); Mirador del Aguila ix (MZFC); NVO i,iii,xii (ADW); Platanitos iii (MZFC); Playas Novillero, Tecuala xi (AMNH); RLNO ix (ADW); SB vi (CAS), vii (ADW), viii,x (LACM), iii,ix,xii (MZFC), xii (UCB); Sayulita vi (LACM); SIN vi,vi,ix,xii; VC iii (MZFC).

Ganyra josephina josepha (Salv. & Godm. 1868), J C M. Bahía de Banderas xi (AMNH); BUC i,iii,xii (ADW); COM viii,xii (CUIC), viii,ix (LACM), xi (AMNH); COM, vic. vii (CUIC); EGUM xii

(ADW); Hwy 200, 30.5 km N Puerto Vallarta iii (LACM); JUM ix (MZFC); i,xii (ADW); Mirador del Aguila ix (MZFC); NVO i,iii,xii (ADW); SB ix (MZFC); SB, Hwy 46 xi (LACM); SIN ix (MZFC), xii (ADW).

NYMPHALIDAE (144 SPECIES)

Dione juno huascuma (Reak. 1866), J C M. BUC xii; EGUM xii; EREF xii (ADW); Hwy 200, 30.5 km N Puerto Vallarta iii; Hwy 200, 33 km N Puerto Vallarta iii (LACM); NAY (AMNH); JUM ix,x (MZFC), ix,xii (ADW); LBA vi,vii; LBA, 4 km E vi; LYB vi,x,xi (MZFC); NVO xii (ADW); Platanitos iii (MZFC); SIN ix (MZFC), xii (ADW); Tecuhuitata xii; Tepetilte vi (MZFC).

Dione moneta poeyii Butl. 1873, J C M. COM ii (USNM); NAY (AMNH); RLNO i (ADW); TEP, E of xii (LACM); VC xi (MZFC).

Agraulis vanillae incarnata (Riley 1926), J C M. Acaponeta, 10 mi S xii (LACM); EREF x (ADW); NAY (Hoffmann 1940: AMNH); Jesús María viii; JUM viii,ix (MZFC), i,ix,xii; LBA i (ADW), vi (MZFC); LYB x; MEC ix (MZFC), i,x; NVO xii (ADW); Río Cañas, (Mex. 15, km 145) vii (RH); SB i,vi,vii (ADW), xi; SIN iv,ix (MZFC); TEP, E of xii (LACM).

Dryadula phaetusa (L. 1758) . SB x (MZFC).

Dryas iulia moderata (Riley 1926), J C M. Aticama xii (ADW); Aticama, 1 km N xii (MZFC); BUC i,xii (ADW); Chacala x (MZFC); COM viii (LACM); EGUM i,x,xii (ADW); EREF x,xii (ADW); NAY (AMNH); Isla María Madre ix,xii (CIB); Islas Tres Marías (Godman & Salvin 1879 1901: AMNH); JUM viii,ix,xi (MZFC), i,ix,xii; LBA i,vi (ADW); vi,vii,ix (MZFC); LBA, 4 km E vi; La Peñita xii; LYB ix,x (MZFC); LSMO ix; Las Piedras x (ADW); MEC ix (MZFC), i,x,xii (ADW); Mirador del Aguila ix (MZFC); Navarelte x (LACM); NVO i,iii,xii (ADW); PAL i,iii,x xii (MZFC); Paso de Mesillas (km 54, Hwy 200) x; RLNO i; SB i,vi (ADW), ii,xii (CAS), viii (LACM, SDNHM), xi (LACM), xii (MZFC); SB, 7 mi E viii (NSMC); San Francisco xii (ADW); San Quintín (km 130, Tepic-Puerto Vallarta) ix (MZFC); SIN iii,iv,vii,ix (MZFC), vi,xii (ADW).

Eueides isabella eva (Fabr. 1793). VC vii (MZFC).

Heliconius charithonia vazquezae W.P. Comstock & F.M. Brown 1950, J C M. Arroyo del Tepeguaje viii (MZFC); Aticama xii (ADW); Aticama, 1 km N vi (MZFC); BUC i,xii (ADW); EGUM i,x,xii (ADW); El Palillo iii (MZFC); EREF x,xii (ADW); El Torreón, 50 km SSE Tepic ix (CIB); Hwy 15, km 1000 viii (NSMC); Hwy 200, 27 km N Puerto Vallarta iii (LACM); NAY (AMNH); Isla María Madre xii (CIB); Islas Tres Marías (Godman & Salvin 1879 1901); JUM i,ix,xii (ADW), iii,iv,vii x; LBA vi,vii,ix (MZFC), i,vi (ADW); LBA, 4 km E vi; La Peñita xii; LYB ix xi (MZFC); LSMO ix (ADW); Matanchén v (MZFC); MEC ix (MZFC), i,x,xii; NVO i,iii,xii (ADW); PAL i,iii,viii,x xii (MZFC); Paso de Mesillas (km 54, Hwy 200) x (ADW); SB (Godman & Salvin 1879 1901, De la Maza 1987), i,vi (ADW, LACM), ii,xi,xii (CAS), ix xi (MZFC); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN iii vii,ix (MZFC), xii (ADW); TEP ix (CIB), x (Gibson & Carrillo 1959); Tepic-Puga xii (LACM); VC iii,iv,vi,x,xii (MZFC).

Heliconius erato cruentus Lamas 1998, as *H. e. punctata* Beutelspacher 1982 by Warren et al. (1998), J C M. Aticama xii (ADW); Aticama, 1 km N vi,xi,xii; Aticama, 2 km N vi; Chacala x; Cocos-Matanchen v (MZFC); EGUM i,x,xii (ADW); Hwy 200, 33 km N Puerto Vallarta iii (LACM); NAY (AMNH); Jalcocotán vii,xii (CIB); JUM i; LBA i,vi (ADW), vi,vii,ix; LBA, 4 km E vi; Matanchen v (MZFC); MEC i; NVO xii (ADW); PAL xii; Peñita de Jaltemba xii; Platanitos iii (MZFC); SB (De la Maza 1987), i,vi,vii (ADW), ii,vi (CAS), viii (LACM), ix,xii (MZFC); SB, 3 mi E viii; SB, 5 mi E viii (CAS); San Francisco xii (ADW); San Quintín (km 130, Tepic-Puerto Vallarta) ix; Sayulita xii (MZFC); Sayulita Punta de Mita ii (LACM); SIN iv,vii,ix,x (MZFC), vi,xii (ADW).

Euptoieta hegesia meridiania Stichel 1938, as *E. h. hoffmanni* Comstock 1944 by Warren et al. (1998), J C M. BUC i,iii,xii (ADW); EGUM i,xii (ADW); El Palillo iii (MZFC); EREF x,xii (ADW); Hwy 15, km 1035 viii (NSMC); Isla María Magdalena xi (CIB); Islas Tres Marías (Godman & Salvin 1879 1901: AMNH); JUM vii ix,xi (MZFC), i,ix,xii; LBA i,vi (ADW); LBA, 4 km E vi; LYB iii,x (MZFC); LSMO ix (ADW); MEC ix (MZFC); i,x,xii; NVO i,iii,xii (ADW); NAY (AMNH); PAL iii,x,xii; Pintadeño x (MZFC); RLNO ix (ADW); SB vi (ADW, CAS), vii (UCB), viii (LACM), ix (SDNHM); SB, 1 mi E viii (NSMC); SIN vi (ADW), iv,vii,ix; VC iv,vii (MZFC).

Vanessa atalanta rubria (Fruhstorfer 1909), J M. LYB x; PAL x; VC x (MZFC).

Vanessa annabella (Field 1971), as *Cynthia annabella* by Vargas et al. (1996), J M. Isla María Magdalena xi (CIB); RLNO xii (ADW).

Vanessa cardui (L. 1758), as *Cynthia cardui* by Vargas et al. (1996), J M. NAY; Islas Tres Marías (AMNH); LYB x; SIN ix; Tepetilte x; VC vi (MZFC).

Vanessa virginiensis (Drury 1773), J C M. LYB x (MZFC); MEC i (ADW); Pintadeño x (MZFC); RLNO i (ADW); VC vi (MZFC).

Nymphalis antiopa antiopa (L. 1758), J C M. LYB viii (MZFC).

Polygonia interrogationis (Fabr. 1798), M. JUM ix; LBA ix (MZFC); VC (De la Maza 1987).

Hypanartia dione ssp. COM, 5 mi SW viii (MZFC). Apparently an undescribed subspecies.

Hypanartia godmanii Bates 1864, J C M. PAL xii (MZFC).

Anartia amathea colima Lamas 1995, J C M. Aticama xii (ADW); Aticama, 2 km N v (MZFC); Bahía de Banderas (AMNH); BUC xii (ADW); Camalote vi (MZFC); COM (AMNH); EGUM i,x,xii (ADW); El Palillo vi (MZFC); EREF x,xii (ADW); Hwy 200, 27 km N Puerto Vallarta iii (LACM); Jalisco (AMNH); JUM viii,ix xii (MZFC), i,ix,xii; LBA i,vi (ADW), vi,ix; LYB iii,iv,ix xi (MZFC); LSMO ix; Las Piedras x (ADW); MEC ix (MZFC), i,vi,x,xii (ADW); Matanchén v; Mirador del Aguila iii,ix (MZFC); NVO i,xii (ADW); PAL i,iii,vii,viii,x (MZFC); Pantanal (AMNH); Paso de Mesillas (km 54, Hwy 200) x (ADW); Peñita de Jaltemba xii; Pintadeño x (MZFC); Playas Novillero (AMNH); RLNO ix (ADW); SB ix,x,xii (MZFC), i,ii (CAS), ii (CAS), i,vi,vii,xii (ADW), viii,x (LACM); SB, 7 mi E viii (NSMC); San Quintín ix; SIN vi,ix (MZFC), xii (ADW); TEP x (LACM); TEP, 17 mi NW xi (CAS); VC iii,x (MZFC).

Anartia jatrophae luteipicta Fruhstorfer 1907, J C M. Aticama xii (ADW); Aticama, 2 km N v; El Palillo vi (MZFC); EREF x,xii (ADW); JUM vii xi (MZFC), i,x,xii (ADW); LBA ix; LYB xi (MZFC); LSMO ix; Las Piedras x (ADW); Matanchén v; MEC ix (MZFC); x (ADW); SB ix,x,xii (MZFC); i,vi,xii (ADW), i,vi (CAS), vi (UCB), viii (LACM); Sayulita vi (LACM); SIN iii (MZFC).

Siproeta epaphus epaphus (Latr. [1813]), J C M. EGUM i (ADW); LBA ix (MZFC), i (ADW); LYB x,xi (MZFC); LSMO ix; MEC i,xii (ADW); PAL i,x,xii; San Quintín ix (MZFC); TEP, 15 mi NW (AMNH).

Siproeta stelenes biplagiata (Fruhstorfer 1907), J C M. Aticama, 1 km N xii (MZFC); EGUM x,xii (ADW); El Palillo iii (MZFC); EREF x (ADW); Jalisco (AMNH); Jesús María viii; JUM iv,vii xi (MZFC), i,ix,xii; LBA i (ADW), ix,x; LYB iv,vi,x,xi (MZFC); LSMO ix (ADW); Las Piedras x (ADW); MEC ix (MZFC), i,x,xii (ADW); Mirador del Aguila ix; PAL x,xii (MZFC); Paso de Mesillas (km 54, Hwy 200) x (ADW); Pintadeño x (MZFC); RLNO ix (ADW); SB (De la Maza 1987), i (ADW), viii (LACM), iii,ix,xi; San Quintín ix (MZFC); Sayulita Punta de Mita ii (LACM); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN ix (MZFC), i,xii (ADW); TEP x (UCB); Tepic-Puga xii (LACM); TEP, 10 mi N (AMNH); VC iii,iv,x (MZFC).

Junonia coenia Hübner [1822], J C M. Jesus María viii; JUM ix,xi; LYB iii,iv,ix; PAL iii,x,xii; SB ix (MZFC); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN iii; VC x (MZFC). It is not always possible to separate this taxon from the following one in western Mexico.

Junonia evarete nigrosuffusa Barnes & McDunnough 1916, as *J. genoveva nigrosuffusa* by Warren et al. (1998), J C M. Acaponeta, 10 mi S xii (LACM); Aticama xii; BUC xii (ADW); COM, vic. vii (CUIC); Hwy 46, 5 mi W Jct Hwy 15 viii (CAS); Jesús María vii (MZFC); JUM ix (MZFC), i,ix,xii (ADW); LYB iii,ix (MZFC); LSMO ix; MEC i; NVO xii (ADW); PAL xii (MZFC); RLNO i,xii

(ADW); SB i (ADW), vi,vii (UCB), xi (LACM); SIN xii (ADW); Tuxpan, 15 mi N x (UCB); VC x (MZFC).

Chlosyne ehrenbergii (Geyer [1833]), as *Anemeca ehrenbergii* by Warren et al. (1998), J C M. El Palillo x (MZFC); NAY (Hoffmann 1940, Kendall & McGuire 1984, Jurado 1990); Jalisco; Pantanal (AMNH); SB (De la Maza 1987).

Chlosyne endeis endeis (Godm. & Salv. 1894), J. NAY (JPB); Jasmines, 3.5 mi NW vii (MZFC, USNM); Jazmines, 2.8 mi NW on Hwy 15 vii (SDNHM); Jazmines, 3.5 mi NW on Hwy 15 vii,viii; La Laguna, 2.8 mi S on Hwy 15 viii (NSMC); Sierra Madre de Nayarit (Hoffmann 1940); Sierra Madre de Tepic (Godman & Salvin 1879 1901, Higgins 1960: BMNH); TEP (LACM).

Chlosyne gloriosa Bauer 1960, J C M. Amatlán (AMNH); Arroyo del Refilón ix (CIB); COM (AMNH), v,x (CIB), viii,ix (USNM), x (MZFC); COM, 5 mi S x (NSMC); COM, 5 mi SW x (MZFC); COM, vic. vii (CUIC); Cruz de Juanacaxtle (De la Maza 1987), ix (NSMC); EGUM xii (ADW); Huajicori, 1.5 mi N vii (NSMC); Jazmines, 3.5 mi NW on Hwy 15 vii (NSMC); JUM iii,vii,ix xi (MZFC), ix (ADW); LBA vii,ix; LYB, 5 km E vi,ix; LYB x (MZFC); Las Piedras x (ADW); MEC ix; PAL x xii (MZFC); Pantanal (AMNH); Punto Camarón (Santa Cruz) (USNM); SB viii,xi (LACM); SB, 7 mi E viii (NSMC); San Quintín (km 130, Tepic-Puerto Vallarta) ix (MZFC); Sayulita Punta de Mita ii (LACM); SIN ix (MZFC); TEP [Type Locality] (Bauer 1960; Higgins 1960), iii,iv,ix (CIB), viii (AMNH, Vázquez & Zaragoza 1979: CIB).

Chlosyne marianna Röbert [1914], J C. TEP, 18 mi N viii; TEP, 25 mi N vi (CAS).

Chlosyne hippodrome hippodrome (Geyer 1837), J C M. Arroyo del Refilón ix (CIB); Chacala x (MZFC); COM (AMNH), vi (USNM), x (CIB); EREF x (ADW); Jalcocotán viii (CIB); Jesús María viii; JUM iii,ix (MZFC), ix (ADW); LBA vi,vii,ix; LBA, 4 km E vi (MZFC); La Colonia, 43 km SE Tepic ix (CIB); LYB v,vi,ix,x; LSMO ix (MZFC), vii (RH), ix (ADW); MEC ix (MZFC); vi,x (ADW); Mirador del Aguila ix; PAL iii,vii,x (MZFC); Paso de Mesillas (km 54, Hwy 200) x (ADW); Pintadeño vi,x (MZFC); RLNO ix (ADW), ix (MZFC); SB viii (LACM, SDNHM); SB, 7 mi E viii (NSMC); San Quintín (km 130, Tepic-Puerto Vallarta) ix (MZFC); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN vii,ix,x (MZFC), i,vi (ADW); Tepetilte v (MZFC); VC x (MZFC).

Chlosyne lacinia crocale (W.H. Edw. 1874), J C M. Arroyo del Refilón ix (CIB); COM iv,ix (CUIC), vii (CIB); EREF x,xii (ADW); El Torreón, 50 km SSE Tepic ix (CIB); NAY (AMNH); Ixtlán del Río viii (CAS); JUM x (MZFC); LBA vi (ADW, MZFC); LBA, 4 km E; LYB x (MZFC); LSMO ix (ADW); MEC ix (MZFC); NVO i,iii (ADW); Pintadeño vi (MZFC); RLNO ix (ADW); SB ix (MZFC), vii (ADW); San Quintín (km 130, Tepic-Puerto Vallarta); SIN ix (MZFC); TEP ix (ADW); Tepic-Puga xii; TEP, 5 10 mi N xii; TEP, E of xii (LACM), xii (LACM); VC vi (MZFC).

Chlosyne eumeda (Godm. & Salv. 1894), as *C. marina dryope* by Warren et al. (1998), J C M. COM (CUIC), vi,xi (AMNH), ix (USNM), x (CIB); COM, 12.3 mi W vii (SDNHM); Cruz de Juanacaxtle (De la Maza 1987); EREF x (ADW); JUM viii x (MZFC), ix (ADW); LBA vi (ADW, MZFC); LBA, 4 km E vi (MZFC); La Fortuna ix (NSMC); LYB ix xi; MEC ix (MZFC); Mirador, El Aguila, Tepic ix (CIB); PAL i,vii,viii,x (MZFC); SB xi (LACM); SIN ix (MZFC).

Chlosyne rosita montana (Hall 1924), J C M. COM v,viii (CUIC), vii (AMNH).

Chlosyne theona ssp., as *Thessalia theona* ssp. by Warren et al. (1998), J C M. Aticama xii (ADW); BUC i,iii,xii (Austin & Smith 1998: ADW); COM (AMNH), viii (CUIC); COM, 3 mi N viii (AME), viii (Austin & Smith 1998: NSMC); EGUM x (ADW); Jesús María viii (MZFC); JUM ix; LBA vi (ADW); LBA, 4 km E vi; LYB ix,x (MZFC); LSMO vii,viii,xii (Austin & Smith 1998: NSMC), vii (RH), viii (AME), ix (ADW); Las Piedras x (ADW); MEC ix (MZFC); NVO i,iii,xii (ADW); PAL iii (MZFC); Puerto Vallarta, 20 mi N viii (Austin & Smith 1998: NSMC); RLNO ix (ADW); SB ix (MZFC), vi (UCB), vii (ADW); SB, 3 mi E viii (Austin & Smith 1998: AME, NSMC); Tepetilte vi (MZFC); TEP ix (AME), ix (Austin & Smith 1998: NSMC); TEP, 10 mi N iii (Austin & Smith 1998: NSMC); Tuxpan, 5 mi N xi (Austin & Smith 1998); VC iii,vi (MZFC). Much of this material represets a blend between *C. theona mullinsi* (Austin & M. J. Smith 1998) and *C. theona brocki* (Austin & M. J. Smith, 1998). See Wahlberg & Zimmerman (2000) for generic change.

Texola anomalus (Godm. & Salv. 1897), J C M. COM, vic. x (CUIC).

Texola elada elada (Hewit. 1868), J C M. COM (AMNH); EREF xii (ADW); Hwy 15, km 211 (S of TEP) vii (RH); Jalisco (AMNH); LYB ix (MZFC); LSMO ix (ADW); TEP vii (CIB), xii (LACM); Tepic-Puerto Vallarta, km 19 viii (CIB); Tepic-Tuxpan, km 20 x (CUIC); VC xii (MZFC).

Microtia elva elva H.W. Bates 1864, J C M. Aticama xii (ADW); Bahía de Banderas (AMNH); Barranca del Oro, Ahuacatlán vii (CIB); COM (AMNH), v (CUIC), x (CIB); COM, 12.3 mi W vii (SDNHM); EGUM x,xii (ADW); El Izote vi (MZFC); EREF x,xii (ADW); Jesús María viii; JUM viii xi (MZFC), ix,xii (ADW); LBA ix; LYB ix,x (MZFC); LSMO ix; Las Piedras x (ADW); MEC vii,ix,xi (MZFC), vi,x,xii (ADW); Mirador del Aguila ix; PAL x (MZFC); Paso de Mesillas (km 54, Hwy 200) x (ADW); SB (AMNH, Godman & Salvin 1879 1901), v (Higgins 1960), x (LACM); Sayulita Punta de Mita ii (LACM); SIN ix (MZFC), vi,xii (ADW); TEP vi (CAS, UCB); TEP, 17 mi NW xi; TEP, 32 mi NW xi (CAS); TEP, 5 10 mi N xii (LACM); VC vi,viii (MZFC).

Phyciodes mylitta thebais Godm. & Salv. 1878, J M. TEP vii (AMNH).

Phyciodes pallescens (R. Feld. 1869), J C M. BUC i,iii,xii (ADW); EREF x (ADW); NAY (Hoffmann 1940); JUM ix (MZFC), ix; NVO xii (ADW); SB x (MZFC); Sierra Madre de Tepic (Godman & Salvin 1879 1901); TEP ix (ADW); VC vi (MZFC).

Phyciodes tharos tharos (Drury 1773), as *P. t. distinctus* Bauer 1975 by Vargas et al. (1996), J M. Jazmines, 2.5 mi N on Hwy 15 vii (NSMC); LSMO vii (RH); RLNO xii (ADW).

Phyciodes phaon phaon (W. H. Edw. 1863), C M. SB vi (ADW).

Anthanassa nebulosa alexon (Godm. & Salv. 1889), as *A. alexon alexon* by Warren et al. (1998), J C M. Ahuacatlán iii (MZFC); EREF xii (ADW); JUM iv (MZFC), xii (ADW); LSMO ix (NSMC); PAL i (MZFC); Paso de Mesillas (km 54, Hwy 200) x (ADW); VC iv,vi (MZFC).

Anthanassa ardys ardys (Hewit. 1864), J C M. Ahuacatlán x (MZFC); COM (CUIC), x (CIB); EGUM xii (ADW); EREF x,xii (ADW); LYB iv,vi,viii x,xii; PAL i,x (MZFC); SIN xii (ADW); TEP xii (LACM); VC iii,iv,vi,xi (MZFC).

Anthanassa tulcis (H.W. Bates 1864), J C M. BUC i,xii (ADW); COM ix (CUIC); EGUM i,x,xii (ADW); El Palillo iii (MZFC); EREF x,xii (ADW); Isla María Madre xii (CIB); Jalcocotán vii (CIB); JUM iii,iv,vii,ix,x (MZFC), i,ix,xii (ADW); LBA vi,ix,x (MZFC), i,vi (ADW); LBA, 4 km E vi (MZFC); LYB vii xi (MZFC); LSMO ix (MZFC), ix; Las Piedras x (ADW); MEC ix (MZFC), i,vi,x,xii (ADW); NVO i,iii,xii (ADW); PAL i,iii,x,xi; Peñita de Jaltemba xii; Platanitos iii (MZFC); Playas Novillero, Tecuala xi (AMNH); SB (Godman & Salvin 1879 1901), i,vi (ADW), ix (CIB), ix (MZFC); SB, 7 mi E viii (NSMC); San Francisco xii (ADW); San Ignacio, 4 rd km S on Hwy 200 ii (LACM); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN vi,vii,ix (MZFC), xii (ADW); TEP xii (LACM); TEP, 32 mi NW xi (CAS); VC viii (MZFC).

Anthanassa ptolyca amator (Hall 1929), J C M. EREF xii (ADW); JUM ix; LBA ix; LBA, 4 km E vi; LYB, 5 km E vi (MZFC); LYB iv,vi,ix xi (MZFC); LSMO vii (NSMC); PAL iii (MZFC); SB vi (ADW), vii (CIB); Tepetilte v,vi (MZFC); VC iii,vi,x (MZFC).

Anthanassa sitalces cortes (Hall 1917), J C M. LYB x,xii; PAL i (MZFC); RLNO ix (ADW); VC vi,x,xii (MZFC).

Anthanassa texana texana (W.H. Edw. 1863), J C M. Jalisco (AMNH); LYB vi,viii,ix (MZFC); RLNO ix (ADW); Sierra Madre de Tepic (Godman & Salvin 1879 1901); Tepetilte vi (MZFC); TEP ix (ADW); VC iii,vi,vii,x (MZFC).

Tegosa guatemalena (H.W. Bates 1864), C. Aticama, 2 km N vi; El Palillo iii (MZFC); EREF x (ADW); JUM iii,ix (MZFC); MEC vii (CIB), x,xii (ADW), x; PAL i (MZFC); SB (Godman & Salvin

1879 1901); SIN iv,ix (MZFC); Tepic-Puga xii (LACM).

Castilia myia (Hewit. [1874]) & *griseobasalis* (Röber 1913), J M. COM vii (CIB); COM, vic. ix (CUIC); EGUM i,x,xii (ADW); EREF x (ADW); Jalcocotán vii (CIB); JUM ix (MZFC), i (ADW); LBA ix (MZFC), i,vi (ADW); LYB ix,x (MZFC); MEC xii (ADW); PAL i,vii,viii,x xii (MZFC); Sierra Madre de Tepic (Godman & Salvin 1879 1901). We have been unable to separate these two taxa with confidence, if they truly both occur in western Mexico.

Historis odius dious Lamas 1995, J C M. EREF x (ADW); JUM iii,viii,ix (MZFC), i,ix,xii (ADW); LBA ix; LYB iii,iv,x (MZFC); Las Piedras x (ADW); MEC ix (MZFC), i,x,xii (ADW); Mirador del Aguila ix; PAL xii; Pintadeño x; SB ix; SIN ix (MZFC), xii (ADW); VC x (MZFC).

Historis acheronta acheronta (Fabr. 1775), as *H. a. cadmus* (Cr. 1775) by Vargas et al. (1996), J M. JUM ix (MZFC).

Smyrna blomfildia datis Fruhstorfer 1908, J C M. EGUM x; EREF x (ADW); NAY (AMNH); Huajicori viii (SDNHM); JUM iii,viii x,xii (MZFC), i,ix,xii (ADW); LBA vii,ix,x (MZFC), i (ADW); LYB iii,iv,ix xi (MZFC); LSMO viii (NSMC), ix (ADW); MEC vi,ix (MZFC), i,x,xii (ADW); Mirador del Aguila ix; PAL i,iii,vii,viii,x,xii; Pintadeño x (MZFC); RLNO ix,xii (ADW); SB (De la Maza 1987), vi (CAS); San Quintín ix; SIN ix (MZFC), xii (ADW); Tepic-Puga xii (LACM); VC i,iii,iv,vi,viii,x,xii (MZFC).

Smyrna karwinskii Geyer 1833, J C M. COM x (USNM); JUM viii,ix; Mirador del Aguila ix (MZFC); San Quintín (km 130, Tepic-Puerto Vallarta) ix; VC iii (MZFC).

Colobura dirce dirce (L. 1758), J C M. EGUM xii; EREF x; JUM i,ix (ADW), viii x; LBA ix,x (MZFC), i (ADW); LYB x; MEC ix (MZFC), i,vi,x,xii (ADW); Mirador del Aguila ix (MZFC); NVO i,xii (ADW); PAL i,x xii; Pintadeño x (MZFC); SB i (ADW); San Quintín (km 130, Tepic-Puerto Vallarta) ix; SIN iv,v,ix (MZFC), xii (ADW).

Biblis hyperia aganisa Boisd. 1836, J C M. Chacala x (MZFC); EGUM i (ADW); Hwy 200, 33 km N Puerto Vallarta iii (LACM); NAY (Hoffmann 1940); JUM ix,xi; LBA vi,ix,x (MZFC), i (ADW); LYB ix; PAL iii,xi,xii (MZFC); SIN x; VC iii (MZFC).

Mestra dorcas amymone (Mén. 1857), J C M. Acaponeta, 10 mi S xii (LACM); LBA vi; Pintadeño x (MZFC); TEP, 5 10 mi N xii; TEP, E of xii (LACM); VC vi (MZFC).

Myscelia cyaniris alvaradia R.G. Maza & Díaz 1982, J C M. COM x (CIB); JUM ix (MZFC); LBA (Jenkins 1984); x (MZFC); LYB (Jenkins 1984), x (MZFC); Lima de Abajo (De la Maza 1987); MEC x (MZFC), i,x,xii (ADW); PAL iii,xii; SIN iv (MZFC); VC x (MZFC).

Myscelia ethusa ethusa (Doyère [1840]), J C M. Tenacatita; TEP (Jenkins 1984: USNM).

Catonephele cortesi R.G. Maza 1982, J C M. LBA i (MZFC); ix (Jenkins 1985: MZFC), ix,x; LYB viii (MZFC); Lima de Abajo (Jenkins 1985, De la Maza 1987); PAL i (MZFC); SIN ix (Jenkins 1985: MZFC); iv,ix (MZFC); VC iii (MZFC).

Eunica monima (Cr. 1782), J C M. COM (Jenkins 1990: AMNH), vii (CUIC), viii (LACM); EGUM i; EREF xii (ADW); Huajicori, 1 mi S vii (SDNHM); Hwy 15, km 211 (S of Tepic) vii (RH); Isla Santa Isabela vii (CAS); Jalisco; JUM (Jenkins 1990), vii ix,xii (MZFC), i,ix,xii (ADW); LBA (Jenkins 1990), i,vi (ADW), ix,x (MZFC); LYB (Jenkins 1990), ix,x (MZFC); LSMO (Jenkins 1990), vii (RH), ix (ADW, MZFC); MEC i,vi,x,xii (ADW), vii,ix,x; Mirador del Aguila ix; PAL i,iii,vii,x xii (MZFC); RLNO ix (ADW); SB (Jenkins 1990), vi (ADW); SB, 7 mi E viii (NSMC); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN (Jenkins 1990), ix (MZFC), vi,xii (ADW); TEP (Jenkins 1990); VC i,viii,x,xii (MZFC).

Eunica caelina agustina R. de la Maza 1982, J. COM, 8.2 mi SW viii (SDNHM).

Eunica tatila tatila (Herr.-Sch. [1855]), J C M. COM (Jenkins 1990: AMNH), xii; COM, vic. vii (CUIC); PAL (Jenkins 1990), x xii (MZFC).

Hamadryas amphinome mazai Jenkins 1983, J C M. COM (Jenkins 1983), vii (CUIC); EGUM xii; JUM viii (MZFC), ix (ADW); LBA ix (MZFC), i (ADW); LYB x,xi (MZFC); LSMO ix (ADW); MEC ix (Jenkins 1983; MZFC), ix (MZFC, USNM), x,xii (ADW); Mirador del Aguila ix (MZFC); PAL i,iii,x,xii; Pintadeño x; SIN iv,ix (MZFC), ix (Jenkins 1983); VC iii,iv,x (MZFC).

Hamadryas atlantis lelaps Godm. & Salv. 1883, J C M. NAY (Hoffmann 1940); JUM x; PAL iii (MZFC).

Hamadryas februa ferentina (Godart [1824]), J C M. Acaponeta (Jenkins 1983), viii (CAS); Chacala x (MZFC); COM (Jenkins 1983); JUM iii,iv,vii ix,xi (MZFC), ix (ADW); LBA i (ADW), vi,ix; LYB viii x (MZFC); LSMO (Jenkins 1983), ix (ADW); MEC vi,ix (MZFC), i,vi,x,xii (ADW); PAL iii,viii; Pintadeño x (MZFC); SB vi (CAS), ix (MZFC); xi (LACM); SB, 7 mi E viii (NSMC); SB, 16 mi E viii (CAS); San Quintín (km 130, Tepic-Puerto Vallarta) ix; SIN iv,vii,ix (MZFC), xii (ADW); TEP (Jenkins 1983); Tepic-Puerto Vallarta, km 19 vii (CIB).

Hamadryas guatemalena marmarice (Fruhstorfer 1916), J C M. Acaponeta (Jenkins 1983), viii (CAS); COM (Jenkins 1983); El Mamey, MEC vi; Jesús María viii; JUM ix,xi,xii (MZFC), i,ix (ADW); LBA vi,ix; LYB ix,x (MZFC); LSMO (Jenkins 1983), ix (ADW); MEC (Jenkins 1983), ix (MZFC); x (ADW); Mirador del Aguila ix; Pintadeño x (MZFC); RLNO i,ix,xii (ADW); SB ix; San Quintín (km 130, Tepic-Puerto Vallarta) ix (MZFC); SIN (Jenkins 1983), xii (ADW), ix (MZFC); TEP (Jenkins 1983); Tres Hermanos (on Hwy 15) viii (NSMC); VC iii,iv,x,xii (MZFC).

Pyrrhogyra neaerea hypsenor Godm. & Salv. 1884, J C M. COM x (CIB); EREF x,xii (ADW); JUM iv,viii xi (MZFC), i,ix (ADW); LBA vi,ix (MZFC), i (ADW); LYB ix,x (MZFC); MEC vi (ADW); Mirador del Aguila ix (MZFC); PAL i,iii,vii,x (MZFC); SB (Godman & Salvin 1879 1901, Hoffmann 1933); SIN vii,ix (MZFC), xii (ADW).

Temenis laothoe quilapayunia R.G. Maza & Turrent 1985, J C M. Cruz de Juanacaxtle ix (De la Maza & Turrent 1985); EGUM x (ADW); El Limón iii; JUM iii,vii,ix xii (MZFC), i,ix (ADW); LBA ix,x (MZFC), i (ADW); LYB iv,viii xi; MEC vi,ix; Mirador del Aguila ix (MZFC); PAL i,x,xii (MZFC); Playas Novillero xii (AMNH); SB xi (LACM); SIN iv,ix (MZFC), xii (ADW); Tepic-Puga xii (LACM).

Epiphile adrasta escalantei Descimon & Mast 1979, J C M. EREF x (ADW); NAY (De la Maza & Turrent 1985); PAL (Jenkins 1986), iii,x,xii (MZFC); SB (Jenkins 1986), (MZFC); VC (Jenkins 1986, De la Maza 1987), iii,xii (MZFC).

Dynamine artemisia ssp. LBA vii,ix; PAL xii (MZFC). Apparently an undescribed subspecies.

Dynamine dyonis Geyer 1837, J C M. EGUM i (ADW); LBA vi,vii,ix; LBA, 4 km E iv,vi; MEC ix; PAL vii,xi,xii; Pintadeño x (MZFC); SB-TEP, km 5 viii (CIB).

Dynamine postverta mexicana d'Almeida 1952, J C M. EGUM i,xii (ADW); Hwy 200, 30.5 km N Puerto Vallarta iii; Hwy 200, 33 km N Puerto Vallarta iii; LBA vi,vii,ix,x (MZFC), i,vi (ADW); MEC ix (MZFC), i,x (ADW); Playas Novillero xii (AMNH); SB xi (LACM); SB, 7 mi E viii (NSMC); San Quintín (km 130, Tepic-Puerto Vallarta) ix; SIN ix (MZFC), vi,xii (ADW).

Diaethria asteria (Godm. & Salv. 1894), J C M. COM (De la Maza & Turrent 1985, De la Maza 1987); viii,ix (AMNH), ix,xii (CUIC), ix (CIB, USNM); El Limon, JUM iii (MZFC); LBA (ADW); LYB (De la Maza & Turrent 1985); MEC iii (MZFC); NAY (Kendall & McGuire 1984); PAL iii,xii (MZFC); SB (Godman & Salvin 1879 1901); TEP (USNM), ix (CAS); VC iii (MZFC).

Adelpha basiloides (H.W. Bates 1865), J C M. EGUM xii (ADW); JUM iii,ix (MZFC), i,xii (ADW); MEC ix (MZFC), i,x,xii (ADW); PAL xii (MZFC).

Adelpha serpa celerio (H.W. Bates 1864), as *A. celerio diademata* Fruhstorfer, [1913] by Warren et al. (1998), J C M. Aticama, 2 km N v (MZFC); COM x (CIB); COM, vic. x (CUIC); EREF x,xii (ADW); JUM ix (MZFC, ADW); LBA vi,ix; LYB vi,ix,x; MEC vi,ix (MZFC), i (ADW); Mirador del Aguila ix (MZFC); PAL x (MZFC); SB x,xi (LACM); SIN ix (MZFC), xii (ADW). See Willmott & Hall (1999) for taxonomic notes.

Adelpha fessonia fessonia (Hewit. 1847), J C M. Camalote vi (MZFC); Chacala x (MZFC); EGUM xii (ADW); JUM iv,viii,ix (MZFC), ix,xii (ADW); LYB iii,vi,viii (MZFC); LSMO viii (AME);

MEC iv,ix (MZFC), x (ADW); Playas Novillero vi; Playas Novillero, 4 mi S (AMNH); SB vi (CAS), x,xi (LACM); San Quintín (km 130, Tepic-Puerto Vallarta) ix (MZFC); Sayulita ix (MZFC); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN vi,xii (ADW); TEP ix; TEP, 22 mi NNW on Hwy 15 vii,viii; Zapata, 3 mi S viii (AME).

Adelpha iphicleola iphicleola (H.W. Bates 1864), as *A. iphiclus massilides* Fruhstorfer, [1916] by Warren et al. (1998), J C. COM viii (AME); COM, vic. (CUIC); El Mamey, Mecatán vi; El Palillo iii,vi (MZFC); El Torreón, 50 km SSE Tepic ix (CIB); Jalcocotán vii,viii (CIB); JUM iv,vii ix; LBA vii,ix (MZFC); La Colonia, 43 km SE Tepic ix (CIB); LYB ix,x; MEC iv,ix; Mirador del Aguila ix (MZFC), ix (CIB); NAY ix (AMNH); PAL i,x,xii; Sayulita ix (MZFC); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN ix (MZFC); TEP ix; TEP, 18 mi N viii (CAS); VC x (MZFC); Zapata viii (AME). See Willmott & Hall (1999) for taxonomic comments.

Adelpha barnesia leucas Fruhstorfer [1916], J C M. MEC xii (ADW); Mirador del Aguila ix; SIN ix (MZFC), xii (ADW).

Adelpha leuceria leuceria (H. Druce 1874), J C. PAL vii,xi,xii (MZFC); RLNO i (ADW).

Adelpha naxia naxia (C. Feld. & R. Feld. 1867), as *A. n. epiphicla* Godm. & Sal. 1884 by Warren et al. (1998), J C M. SB-TEP, km 5 vii (CIB); JUM ix (MZFC).

Adelpha phylaca phylaca (H.W. Bates 1866), J C M. COM x (CUIC); EGUM xii (ADW); JUM x (MZFC), i,ix (ADW); LBA ix (MZFC), i (ADW); LYB vi,x; PAL x,xii (MZFC); SB ix,xii (MZFC); SIN xii (ADW); Tepetilte vi (MZFC).

Adelpha paraena massilia (C. Feld. & R. Feld. 1867), as *A. serpa massilia* by Warren et al. (1998), J C M. COM, vic. xi (CUIC); EGUM xii (ADW); EREF x (ADW); Jalisco (AMNH); JUM i,ix; LBA i,vi (ADW); La Colonia, 54 km SSE Tepic ix (Beutelspacher 1976, as *A. massilia*); LSMO ix; MEC i,vi,x,xii (ADW); Mirador, El Aguila, TEP ix (Beutelspacher 1976, as *A. massilia*); SIN xii (ADW); TEP, 5 mi N xii; Tepic-Puga xii (LACM); Torreón, 50 km SSE TEP ix (Beutelspacher 1976, as *A. massilia*).

Adelpha paroeca paroeca (W. H. Bates 1864), as *A. p. emathia* (R. Feld. 1869) by Vargas et al. (1996), J M. COM x (AMNH).

Marpesia chiron marius (Cr. 1780), J C M. BUC, 5 mi N ix (UCB); EGUM i,x; EREF x,xii (ADW); JUM viii x (MZFC), i,ix,xii; LBA i,vi (ADW), ix; LYB viii,ix (MZFC); LSMO vii (RH), ix (ADW); MEC ix (MZFC), i,vi,x,xii (ADW); Micro. Santa Bárbara, 3 mi W viii (SDNHM); NAY (AMNH); PAL x (MZFC); Paso de Mesillas (km 54, Hwy 200) x (ADW); San Quintín ix; SIN ix (MZFC), xii (ADW); TEP, 18 mi N viii (CAS); TEP, 20 mi S viii (LACM); VC viii (MZFC).

Marpesia petreus ssp., as *M. p. tethys* (Fabr. [1777]) by Warren et al. (1998), J C M. EGUM x,xii; EREF x (ADW); JUM vii,ix (MZFC), ix (ADW); LYB iv,vi,ix (MZFC); LSMO vii (RH), ix (ADW); MEC ix (MZFC), x (ADW); NAY (AMNH); Paso de Mesillas (km 54, Hwy 200) x (ADW); SB vii (UCB), viii (LACM, SDNHM), xii; SIN ix (MZFC). Apparently an undescribed subspecies.

Archaeoprepona demophon occidentalis Stoffel & Descimon 1974, J C M. COM, vic. x (CUIC); JUM viii x,xii (MZFC), ix,xii (ADW); LBA ix,x (MZFC); LYB iv,viii (MZFC); LSMO ix (ADW); Lima de Abajo (De la Maza 1987); MEC ix (MZFC), x (ADW); PAL x,xi; SB ix; SIN ix (MZFC), xii (ADW); VC xii (MZFC).

Archaeoprepona demophoon mexicana Llorente, Descimon & Johnson 1993, J C M. COM x (CIB); COM, vic. iii (CUIC); JUM ix xii (MZFC), ix,xii; LBA i (ADW), ix; LYB iii,x,xi (MZFC); LSMO viii (NSMC), ix (ADW); Lima de Abajo (De la Maza 1987); MEC x (MZFC), x (ADW); Mirador del Aguila ix; PAL iii,vii,x xii; SB ix (MZFC); SIN xii (ADW), iv,vi,ix,xii; VC x (MZFC).

Prepona deiphile lambertoana Llorente, Luis & González 1992, M. RLNO ix (MZFC).

Prepona laertes octavia Fruhstorfer 1905, J C M. JUM ix,x; LBA ix; LYB iii,x,xi; MEC x (MZFC), x (ADW); PAL x,xii; Pintadeño iv,x; SB ix; SIN iv,ix (MZFC), xii (ADW).

Zaretis callidryas (R. Feld. 1869), J C M. COM, vic. x (CUIC); JUM viii-x,xii (MZFC); LSMO ix (ADW); VC iii (MZFC).

Zaretis ellops (Ménétriés 1855), as *Z. e. anzuletta* Fruhstorfer 1909 by Warren et al. (1998), J C M. El Palillo vi (MZFC); EREF x (ADW); JUM viii,ix xii (MZFC), ix,xii (ADW); LBA ix,x; LYB x (MZFC); LSMO ix (MZFC), ix (ADW); MEC ix (MZFC), i,x,xii (ADW); PAL x (MZFC); Paso de Mesillas (km 54, Hwy 200) x (ADW); SB-TEP, km 5 viii (CIB); SIN iv,vii,ix (MZFC), xii (ADW); VC iii,xii (MZFC).

Siderone galanthis ssp., as *S. galanthis* (Cr. 1775) by Warren et al. (1998), J C M. EGUM xii (ADW); JUM iii,ix xii; LBA ix,x (MZFC); Lima de Abajo (De la Maza 1987); MEC ix (MZFC), x (ADW); SIN ix (MZFC), xii (ADW). Apparently an undescribed subspecies.

Anaea troglodyta aidea (Guérin [1844]), J C M. COM ix (LACM), x (CIB); COM, 5 mi SW x (MZFC); El Venado, 4.3 mi E vii (SDNHM); Jesús María viii (MZFC); JUM iii,vii xii (MZFC), i,ix (ADW); LBA ix,x (MZFC); LYB ix,x (MZFC); LSMO ix (ADW); MEC viii,ix (MZFC), x (ADW); Mirador del Aguila ix (MZFC); PAL vii,xii (MZFC); Pintadeño iv (MZFC); RLNO ix (ADW); SB ix (MZFC); SB-TEP, km 5 vii (CIB); Sierra de Nayarit (AMNH); SIN vii,ix (MZFC); TEP, 24 mi SE viii (CAS); VC iii,iv,vi,x (MZFC).

Consul electra ssp., as *C. e. castanea* Llorente & Luis 1992 by Vargas et al. (1996), J M. LYB iii,x,xi (MZFC); Lima de Abajo (De la Maza 1987); PAL i,iii,x-xii; SB xii (MZFC).

Consul fabius cecrops (Doubleday [1849]), J C M. EGUM i,xii (ADW); JUM iv,ix,xii (MZFC), ix (ADW); LBA iv,vi,ix,x (MZFC), i (ADW); Lima de Abajo (De la Maza 1987); MEC ix (MZFC), i,x (ADW); PAL iii,x,xii (MZFC); Paso de Mesillas (km 54, Hwy 200) x (ADW); Pintadeño vi (MZFC); SB iii (MZFC); SIN iv,ix (MZFC), xii (ADW); VC vi (MZFC).

Fountainea eurypyle glanzi (Rotger, Escalante & Coronado 1965), J C M. COM (AMNH); COM, 5 mi S x; JUM ix; LBA ix,x; LYB ix xi (MZFC); MEC x,xii (ADW); PAL iii,x,xi; Pintadeño iv (MZFC); SIN ix; VC iv,x (MZFC).

Fountainea glycerium glycerium (Doubleday [1849]), J C M. COM (AMNH); COM, 5 mi S x; COM, 5 mi SW x; LBA x; LYB x,xi (MZFC).

Fountainea nobilis rayoensis (J. Maza & Díaz 1978). LBA x; LYB iv,ix,x; SIN iv; VC iv (MZFC).

Memphis pithyusa pithyusa (R. Feld. 1869), J C M. COM, 5 mi S x; JUM x,xi; PAL iii,vii,viii; VC iii (MZFC).

Asterocampa idyja argus (Bates 1864), J M. Bahía de Banderas xi; COM ix (AMNH); COM, 5 mi S x; COM, 5 mi SW x (MZFC); JUM viii; LYB x (MZFC); Mirador del Aguila ix (MZFC); NAY (Friedlander 1986, 1987); VC x (MZFC).

Doxocopa laure laure (Drury 1773), as *D. l. acca* (C. Feld. & R. Feld. 1867) by Warren et al. (1998), J C M. Bahía de Banderas xi (AMNH); BUC iii,xii (ADW); El Aguila, Tepic ix (CIB); EGUM i (ADW); El Palillo iii (MZFC); Hwy 200, 27.5 km N Puerto Vallarta iii; Hwy 200, 30.5 km N Puerto Vallarta iii (LACM); JUM ix,xi (MZFC), ix,xii; Las Piedras x (ADW); Lima de Abajo (De la Maza 1987); MEC ix (MZFC); Micro. Santa Bárbara, 3 mi W viii (SDNHM); NVO i,iii,xii (ADW); Playas Novillero, Tecuala xi (AMNH); SB vii (ADW), xi (LACM); Sayulita ix; SIN ix (MZFC), xii (ADW).

Doxocopa pavon theodora (Lucas 1857), J C. COM, 5 mi S x (MZFC).

Morpho achilles guerrerensis Le Moult & Réal 1962, M. TEP vi (CAS). It is possible that this specimen is mis-labeled; the absence of other records from the state is curious.

Morpho polyphemus polyphemus Westw. 1851, as *Pessonia p. polyphemus* by Warren et al. (1998), J C M. Arroyo del Refilón ix (CIB); Chacala x (MZFC); COM vi (AMNH); EGUM xii (ADW); El Palillo vi (MZFC); EREF x (ADW); JUM ix xi (MZFC), i,ix; LBA i,vi (ADW), ix; LBA, 4 km E vi; LYB v,vi,ix xi; LSMO ix (MZFC), ix (ADW); MEC ix (MZFC), i,x (ADW); Mirador, El Aguila, Tepic ix (CIB, MZFC); Navarelte x (LACM); NVO xii (ADW); PAL x (MZFC); Paso de Mesillas (km 54, Hwy 200) x (ADW); Pintadeño x (MZFC); RLNO ix (ADW); SB (De la Maza

1987), i,vi,vii (ADW), vi,ix (CAS), vi,x (LACM), ix,xi,xii (MZFC), vi (UCB); SB, 7 mi E vii (SDNHM); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN (De la Maza 1987), vi,xii (ADW), vii,ix (MZFC); TEP, 25 mi NW x (AMNH); VC viii,x xii (MZFC).

Opsiphanes boisduvallii Doubleday [1849], as *O. boisduvalii* by Warren et al. (1998), J C M. EREF x (ADW); JUM iii,vii-xii (MZFC); ix,xii (ADW), ix,x,xi; LBA ix,x (MZFC); LYB (De la Maza 1987), viii,x,xi (MZFC); LSMO ix (ADW); MEC ix,x; Mirador del Aguila ix; PAL x; Pintadeño x; SIN ix (MZFC); TEP, 22 mi NNW on Hwy 15 viii (AME); VC viii,x (MZFC).

Opsiphanes tamarindi tamarindi C. Feld. & R. Feld. 1861, J C M. SB (De la Maza 1987); VC iv (MZFC).

Opsiphanes cassina fabricii (Boisd. 1870), as *O. invirae fabricii* by Warren et al. (1998), J C M. JUM iv,vii,viii,xi (MZFC), xii (ADW); LBA ix (MZFC); NVO i,iii,xii (ADW); San Quintín (km 130, Tepic-Puerto Vallarta) ix; SB ix (MZFC), x (LACM); SIN iv,ix,x (MZFC), xii (ADW).

Caligo uranus (Herr.-Sch. 1850). Jesús María vi (CAS). It is possible that this specimen is mis-labeled; the absence of other records from the region is curious.

Danaus eresimus montezuma Talbot 1943, J C M. Arroyo del Refilón ix (CIB); BUC iii,xii; EGUM xii; EREF x,xii (ADW); Isla María Madre xi; Isla María Magdalena xi (CIB); JUM ix,x (MZFC), i,ix,xii; LBA i; MEC x; NVO i,xii (ADW); Palillo Nuevo ix (CIB); SB (De la Maza 1987), i (ADW), iii,ix (MZFC), vi (CAS); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN iii,ix (MZFC), xii (ADW).

Danaus gilippus thersippus (H.W. Bates 1863), J C M. Acaponeta viii (CAS); Arroyo del Refilón ix (CIB); Aticama xii; BUC i,xii; EGUM xii (ADW); El Torreón, 50 km SSE Tepic ix (CIB); JUM i,ix,xii (ADW), ix; LBA ix (MZFC), i (ADW); LBA, 4 km E vi; LYB x; MEC vi,ix (MZFC), i (ADW); NAY (AMNH); NVO i,iii,xii (ADW); PAL iii,x; Pintadeño x (MZFC); RLNO xii (ADW); SB i (ADW), viii,ix,xii; SIN ix (MZFC), xii (ADW); TEP iv; VC vi (MZFC).

Danaus plexippus plexippus (L. 1758), J C M. BUC xii (ADW); LYB vii,ix (MZFC); MEC i (ADW); NAY (AMNH); SB vi (ADW), Sierra Madre de Tepic (Godman & Salvin 1879 1901); TEP iv (MZFC).

Lycorea halia atergatis Doubleday [1847], J C M. COM iii,viii (AMNH); EGUM x,xii; JUM ix (MZFC), ix (ADW); LBA i vi,x; LYB x; MEC x (MZFC), vi (ADW); Mirador del Aguila ix; PAL x,xii (MZFC); Paso de Mesillas (km 54, Hwy 200) x (ADW); SIN ix; VC vi (MZFC).

Melinaea ethra flavicans C.C. Hoffmann 1924, J C M. COM iv (CUIC); Lima de Abajo (De la Maza 1987); PAL xii (MZFC).

Dircenna klugii klugii (Geyer 1837), C M. COM v (CUIC).

Episcada salvinia portilla J. Maza & Lamas 1978, J M. LYB x (MZFC); RLNO ix (ADW); VC (De la Maza 1987), iv,vi (MZFC).

Pteronymia cotytto cotytto (Guérin [1844]), J C. Río Cañas, (km 145, Hwy 15) vii (RH).

Pteronymia rufocincta (Salvin 1869), J C. Aticama, 2 km N v (MZFC); La Libertad, 3 km W iv; LYB v,ix xi; PAL xii (MZFC); RLNO ix (ADW); Tepetilte v (De la Maza 1987); Tepic-Puerto Vallarta, km 19 vii,viii (CIB); VC (De la Maza 1987), iii,iv,vi,x xii (MZFC).

Greta annette moschion (Godm. 1901), J C M. RLNO ix (ADW, MZFC); VC vii (MZFC).

Greta morgane morgane (Geyer 1837), J C M. Cañada de Sangangüey vii (MZFC); COM viii,ix (CMNH), xii (CUIC); EGUM xii (ADW); Jalcocotán Miramar xii (LACM); LBA i (ADW), vi (MZFC); La Libertad (De la Maza 1987), iv; La Libertad, 3 km W iv; LYB iv vi,viii xi (MZFC); MEC i,xii (ADW); PAL i,viii,x xii (MZFC); RLNO ix (ADW); VC iii,iv,vi,vii,xi (MZFC).

Libytheana carinenta mexicana Michener 1943, J C M. COM x (CIB); Jesús María viii; JUM vii ix (MZFC), ix (ADW); LSMO vii (RH), ix (ADW); MEC viii (MZFC); SB-TEP, km 5 viii (CIB); SIN vii (MZFC).

Pierella luna rubecula Salv. & Godm. 1868. COM, 5 mi S x (MZFC). It is possible that this specimen is mis-labeled; the absence of other records from the region is curious.

Manataria hercyna maculata (Hopffer 1874), as *M. maculata* by Warren et al. (1998), J C M. COM xii (AME); JUM xii; LYB iii,x,xi (MZFC); LSMO viii (NSMC); Mirador del Aguila ix; PAL xii (MZFC); RLNO ix (ADW), ix; VC iii,iv,x,xii (MZFC).

Cyllopsis diazi L. Miller, 1974, C. LYB xi (MZFC).

Cyllopsis hilaria (Godm. 1901), M. VC iv (MZFC).

Cyllopsis caballeroi Beutelspacher 1982, J C. NAY (Miller & De la Maza 1984); LBA ix; LYB vi,x,xi; PAL xii (MZFC).

Cyllopsis hedemanni hedemanni R. Feld. 1869, J C M. SIN iv; VC iii,iv,xii (MZFC).

Cyllopsis nayarit R. Chermock 1947, J M. COM x (CUIC), x (Miller 1974); LYB x (MZFC); RLNO ix (ADW); VC iii (MZFC).

Cyllopsis pephredo (Godm. 1901), M. VC x (MZFC).

Cyllopsis perplexa L. Miller 1974, M. JUM ix; PAL iii; VC iii,iv (MZFC). Records of this species, *hilaria*, and *pephredo* herein may possibly all refer to one species.

Cyllopsis pyracmon pyracmon (Butl. 1867), M. LBA ix; LYB x (MZFC); RLNO ix (ADW); VC iii,iv (MZFC); Zapata, 3 mi S viii (Miller 1974; AME).

Cyllopsis steinhauserorum L. Miller 1974. LYB xi (MZFC). This record may refer to *C. diazi*.

Cyllopsis suivalenoides L. Miller 1974, J C M. RLNO ix,xii (ADW), ix (MZFC).

Cyllopsis windi L. Miller 1974, C M. PAL iii; VC iii,iv (MZFC). This species may be a dry season form of *C. nayarit*.

Euptychia fetna Butl. 1870, J C M. COM x (CUIC); Jazmines, 2.8 mi N on Hwy 15 vii (NSMC); PAL x (MZFC); TEP, S of ix (AME); VC viii (MZFC).

Hermeuptychia hermes (Fabr. 1775), J C M. Ahuacatlán xi (MZFC); Bahía de Banderas (AMNH); BUC i,iii,xii (ADW); COM (AME), ix,x (CIB); EREF x (ADW); Jalcocotán Miramar xii (LACM); JUM iii,vii xii; LBA vii,ix,x; LBA, 4 km E vi (MZFC); LYB iii,ix xii (MZFC); LSMO (AME), vii (RH, NSMC), ix; Las Piedras x (ADW); MEC v,ix (MZFC); NVO i,xii (ADW); PAL x (MZFC); Playas Novillero (AMNH); SB ix (MZFC); SIN ix (MZFC); TEP (AME), vi,ix (ADW); Tepic (Aeropuerto) ix (CIB); TEP, E of ix (LACM); VC x (MZFC).

Megisto rubricata pseudocleophes Miller 1976, J C M. Sierra Madre de Tepic (Godman & Salvin 1879 1901); VC iv (MZFC).

Pareuptychia ocirrhoe (Fabr. 1776), M. PAL ii,xii (MZFC).

Pindis squamistriga R. Feld. 1869, J C M. COM ix (CUIC); LYB x,xi; Pintadeño x (MZFC); RLNO ix (ADW); TEP xii (LACM); VC i,iii,iv,x,xii (MZFC).

Taygetis kerea kerea Butl. 1869, M. Zapata, 3 mi SE viii (AME).

Taygetis mermeria griseomarginata L. Miller 1978, J C M. COM iii (CUIC), x (Miller 1978, AME, CUIC); JUM iv,x; LYB x,xi (MZFC); MEC i (ADW); PAL iii,xii; VC iii,iv (MZFC).

Taygetis uncinata Weymer 1907, J C M. Acaponeta, 10 km S xii (LACM); Aticama, 1 km N vi (MZFC); EGUM x,xii (ADW); JUM i (ADW), iv,vii,ix xii (MZFC); LBA i (ADW), ix,x (MZFC); MEC x; Paso de Mesillas (km 54, Hwy 200) x (ADW); San Quintín (km 130, Tepic-Puerto Vallarta) ix (MZFC); SIN x (MZFC), xii (ADW); VC iii (MZFC).

Taygetis virgilia (Cr. 1776), C. Jalcocotán Miramar xii (LACM); JUM vii,xi,xii; LYB vi,ix (MZFC); MEC x (ADW); PAL vii,xii; SB xii; SIN x,xii (MZFC), xii (ADW); TEP, E of xii (LACM); VC iii,xii (MZFC).

Taygetis weymeri Draudt 1912, J C M. COM x,xi (CUIC); COM, 5 mi S viii; COM, 5 mi SW viii,xi (MZFC); Jalcocotán Miramar xii (LACM); LBA ix; LBA, 4 km E vi; LYB ix (MZFC); PAL i (MZFC); RLNO xii (ADW); TEP, S of v (AME); VC i,iii,x (MZFC).

Cissia pompilia (C. Feld. & R. Feld. 1867). JUM viii (MZFC).

Cissia themis (Butl. 1867), as *Vareuptychia themis* by Warren et al. (1998), J C M. COM iv (CUIC); COM, 3 mi N viii (AME); EGUM x,xii (ADW); El Palillo iii (MZFC); Jalcocotán vii (CIB); JUM i,ix (ADW), iii,iv,vii,ix xii (MZFC); LBA i (ADW), iii,vi,vii,ix,x; LBA, 4 km E vi; LYB iii,iv,vi,ix xii (MZFC); LSMO

viii (AME), ix (ADW, MZFC); MEC xii (ADW); Mirador del Aguila ix (MZFC); Otate, Tepic xii (CIB); PAL i,iii,xi,xii (MZFC); Paso de Mesillas (km 54, Hwy 200) x (ADW); Pintadeño v,x; SIN v,ix,xii (MZFC), xii (ADW, MZFC); Tepetilte vi (MZFC); TEP, 22 mi NNW on Hwy 15 viii (AME); VC i,iii,iv,ix,x,xii (MZFC); Zapata viii (AME).

Cissia undina (Butl. 1867), as *Vareuptychia similis* (Butl. 1867) by Warren et al. (1998), J C M. COM viii (AME); COM, 5 mi SW viii (MZFC); EGUM x (ADW); Jesús María viii; JUM viii,ix (MZFC), ix; LBA vi (ADW), ix; LYB ix,x; LSMO ix; MEC ix (MZFC), x (ADW); San Quintín (km 130, Tepic-Puerto Vallarta) ix; SB ix (MZFC), vi (ADW); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN vi (ADW), ix (MZFC); TEP viii (AME); TEP, 5 10 mi N xii (LACM); Tomatlan ix; VC viii (MZFC); Zapata viii (AME).

LYCAENIDAE (114 SPECIES)

Euselasia eubule ssp., as *E. eubule* (R. Feld. 1869) by Vargas et al. (1998), J C M. JUM iii (MZFC); LBA i (ADW); LYB viii; PAL i,x xii (MZFC).

Euselasia aurantiaca ssp, as *E. aurantiaca* (Sal. & Godm. 1868) by Warren et al. (1998), J C M. RLNO i; VC iv,xi,xii (MZFC).

Mesosemia tetrica Stichel 1910, as *M. lamachus* (Hewit. 1857) by Warren et al. (1998), J C M. EGUM xii (ADW); Jalcocotán Miramar xii (LACM); LBA ix (MZFC), i (ADW); LYB ix,xi; PAL i,iii,x xii (MZFC). Records of *M. lamachus* (Hewit. 1857) from western Mexico refer to this species.

Eurybia elvina elvina Stichel 1910, J. COM ix (AMNH); EGUM xii; LBA i (ADW); LYB ix (MZFC); MEC i (ADW); TEP, 5 10 mi N xii (LACM).

Napaea umbra ssp., as *N. u. umbra* (Boisd. 1870) by Warren et al. (1998), J C M. COM viii (AMNH); COM, 8.2 mi SW viii (SDNHM); EGUM xii; JUM i; MEC i (ADW); PAL iii (MZFC); Sayulita Punta de Mita ii (LACM); SIN xii (ADW).

Rhetus arcius beutelspacheri Llorente 1988, J C M. COM v (CUIC), viii x (Llorente 1988: AMNH), EREF x; LBA i (ADW); LYB ix (Llorente 1988: MZFC); MEC x (ADW); PAL iii,xii (Llorente 1988: MZFC); Zapata, 3 mi SE viii (Llorente 1988: AME).

Calephelis argyrodines (Bates 1866), C. Islas Tres Marías (Godman & Salvin 1879 1901). This record may refer to another species.

Calephelis nemesis nemesis (W.H. Edw. 1871), J C M. Hwy 15, km 211 (S of Tepic) vii (RH).

Calephelis perditalis perditalis Barnes & Mc Dunnough 1918, J C M. BUC xii; EREF x; JUM ix,xii; LSMO ix; MEC x,xii; NVO i,xii; RLNO ix; SIN xii (ADW). Some of these records may refer to *C. nemesis* or *C. matheri* McAlpine 1971.

Calephelis mexicana McAlpine 1971, C J. BUC xii; EREF x,xii; JUM i,ix,xii; LBA i; MEC i,x,xii; Paso de Mesillas (km 54, Hwy 200) x; SB i; SIN xii (ADW); TEP (McAlpine 1971). These records may also represent *Calephelis fulmen* Stichel 1910.

Calephelis sinaloensis sinaloensis McAlpine 1971, M. EREF xii; RLNO i,xii (ADW). These records may also represent *Calephelis dreisbachi* McAlpine 1971.

Calephelis montezuma McAlpine 1971, J C. EGUM i,xii; JUM i,ix,xii; LBA i; MEC i,x (ADW); SB (McAlpine 1971); SIN xii (ADW).

Calephelis acapulcoensis McAlpine 1971, J M. COM iv (AMNH). As in Vargas et al. (1996) and Warren et al. (1998), all *Calephelis* determinations presented herein should be considered tentative (except those from McAlpine 1971), since genitalic dissections have not been made to confirm determinations of ADW specimens. No attempt has been made to include records from MZFC *Calephelis* specimens.

Caria ino ino Godm. & Salv. 1866, J C M. NVO xii (ADW).

Baeotis zonata zonata R. Feld. 1869, as *B. z. simbla* (Boisd. 1870) by Warren et al. (1998), J C M. JUM iv (MZFC); LBA i (ADW); MEC vi (ADW, MZFC); SB vi (ADW); TEP, 24 mi SE viii (CAS).

Lasaia sula sula Staudinger 1888, J C M. Bahía de Banderas xi (AMNH); COM viii (Clench 1972: AMNH); JUM viii x (MZFC); LSMO ix (ADW).

Lasaia agesilas callaina Clench 1972, J C M. Arroyo del Refilón ix (CIB); COM (Clench 1972), viii,ix (AMNH); JUM ix (ADW); LYB ix; PAL xii (MZFC); TEP, 27 mi N Jct Hwy 195 vi (LACM).

Lasaia maria maria Clench 1972, J C M. COM viii (AMNH); COM, vic. viii (CUIC); Jesús María viii (MZFC); LBA i; LSMO ix; MEC i (ADW); Zapata viii (AME).

Melanis pixe pixe (Boisd. 1836), as *M. p. sexpunctata* Seitz 1917 by Warren et al. (1998), J C M. COM viii (AMNH); LBA vi (ADW); LBA, 4 km E vi (MZFC); MEC i (ADW); SB vi (CAS); San Quintín ix (MZFC).

Melanis cephise cephise (Ménétriès 1855), J C M. Aticama, 2 km N v; Fracc. Palmar, Los Cocos (SE of San Blas) iii (MZFC); Jalisco viii; Playas Novillero xi,xii (AMNH); SB i,vi (ADW).

Anteros carausius Westw. [1851], J C M. COM viii (AME, AMNH); EREF x (ADW); Huajicori, 1 mi S vii (SDNHM); JUM xi (MZFC); LBA i (ADW); LYB x; PAL xii (MZFC); SB vi (CAS); SIN vi (ADW), vii (MZFC); Tepic-Puga xii (LACM); Zapata viii (AME).

Calydna sinuata R. Feld. 1869, M. Isla María Magdalena xii (AMNH). This may actually refer to the next species.

Calydna hiria hegias R. Feld. 1869, as *C. sternula hegias* by Warren et al. (1998), J C M. Isla María Madre xii; Isla María Magdalena ix (CIB).

Emesis mandana furor Butl. & Druce 1872, J C M. COM viii (AME); JUM i,ix,xii; LBA i (ADW); LYB x (MZFC); LSMO ix (ADW); TEP, 2.5 mi NE viii (AME); VC iv (MZFC).

Emesis vulpina Godm. & Salv. 1886, J C M. EGUM x; Las Piedras x (ADW); Playas Novillero, Tecuala xi (AMNH); SB (Godman & Salvin 1879 1901), vi (ADW).

Emesis tenedia C. Feld. & R. Feld. 1861, J C M. COM (AMNH), v (CUIC); EREF xii; JUM i; LBA i (ADW), ix; LYB vi,ix xi (MZFC); LSMO viii (AME), ix (ADW); PAL iii,x,xii (MZFC); SIN xii (ADW), ix; VC iii,iv,vi,xi (MZFC).

Emesis zela zela Butl. 1870, J C M. RLNO ix (ADW).

Emesis emesia emesia (Hewit. 1867), J C M. EGUM xii (ADW); El Mamey, MEC vi (MZFC); JUM ix (ADW), iv,vii,viii; LYB ix; MEC ix (MZFC), i,x (ADW); PAL vii (MZFC); SIN xii (ADW); TEP viii (AME).

Apodemia hypoglauca hypoglauca (Godm. & Salv. 1878), J C M. LSMO ix (ADW).

Apodemia walkeri Godm. & Salv. 1886, J C M. Ixtlán del Río viii (CAS); LSMO viii (AME); Playas Novillero, Tecuala vi (AMNH).

Synargis calyce mycone (Hewit. 1865), J C M. JUM i,xii (ADW).

Hypophylla zeurippa (Boisd. 1836), as *Calospila zeurippa* by Warren et al. (1998), J C M. SB vii (CIB).

Adelotypa eudocia (Godm. & Salv. 1897), C M. EGUM x (ADW).

Theope eupolis Schaus 1890, J C M. Bahía de Banderas xi (AMNH); NVO i,xii (ADW); SB iii (MZFC), x (LACM), vi; SIN xii (ADW), ix (MZFC). *Theope diores* Godm. & Salv. 1897 was recently shown by Hall (1999) to be a synonym of *eupolis*.

Theope publius incompositus Hall 1999, as *T. publius* C. Feld. & R. Feld, 1861 by Warren et al. (1998), J C M. NVO i,xii (ADW); SIN vi,ix (MZFC).

Theope bacenis Schaus 1890, as *T. mania* Godm. & Sal. 1897 by Warren (1998), C. COM i,xi (CUIC), x (AMNH); EGUM x,xii; EREF x (ADW); LYB x; PAL vii (MZFC); SB (Godman & Salvin 1879 1901, BMNH).

Eumaeus toxea (Godart [1824]), J C M. Camino Palapita xi (MZFC); COM v (CUIC).

Evenus regalis (Cr. 1775), J C M. SIN xii (ADW).

Laothus erybathis (Hewit. 1867), as *"Thecla" erybathis* by Vargas et al. (1996), J M. RLNO i (ADW).

Bussa busa (Godm. & Salv. 1887), as *"Thecla" busa* by Vargas et al. (1996), J M. LYB ix,x (MZFC).

Allosmaitia strophius (Godart 1824), J C M. SB vi; MEC vi (ADW).

Pseudolycaena damo (H. Druce 1875), J C M. EREF viii (MZFC), x (ADW); NAY (AMNH); JUM i (ADW), viii,ix,xi (MZFC); LBA i (ADW); vi,ix,x; LYB ix xi (MZFC); MEC x,xii (ADW); PAL x,xii (MZFC); SB i,vii (ADW); SIN vi,ix (MZFC).

Atlides gaumeri (Godm. 1901), J C M. LSMO viii (AME).

Paiwarria umbratus (Geyer 1837), J C M. JUM ix,xi; LYB ix (MZFC);

Sierra Madre de Tepic (Godman & Salvin 1879 1901).
"Thecla" ligurina (Hewit. 1874), J C. RLNO xii (ADW).
Arawacus sito (Boisd. 1836), J C M. EGUM xii (ADW); NAY (AMNH); LBA i,vi (ADW), vi,vii,ix; LBA, 4 km E vi; LYB ix,x (MZFC); MEC xii (ADW); PAL iii,vii,xi,xii; SB ix; SIN iv,ix (MZFC), xii (ADW).
Arawacus jada (Hewit. 1867), J C M. COM (CUIC); Hwy 15, km 211 (S of Tepic) vii (RH); NAY (AMNH); JUM ix (ADW), vi,ix,xi; LYB ix,x; Mirador del Aguila iii (MZFC); NVO xii (ADW); PAL iii,xii (MZFC); Sierra Madre de Tepic (Godman & Salvin 1879 1901).
Rekoa meton (Cr. 1779), J C M. EREF xii (ADW); LBA i (ADW), ix (MZFC); NAY (AMNH); SIN xii (ADW).
Rekoa palegon (Cr. 1780), J C M. JUM xii (ADW), iii (MZFC); LBA i (ADW); LYB x (MZFC); MEC I (ADW); NAY (AMNH); NVO i; RLNO ix,xii (ADW); Tepic-Puga xii (LACM); SB vi; SIN xii (ADW).
Rekoa zebina (Hewit. 1869), J C M. COM v (Robbins 1991); SIN ix (MZFC).
Rekoa marius (Lucas 1857), J C M. JUM iv,xi (MZFC), ix (ADW); LSMO, 2.8 mi S on Hwy 15 viii; LYB ix; MEC ix (MZFC), x; NVO i (ADW).
Rekoa stagira (Hewit. 1867), J C M. LBA i; SB i (ADW).
Ocaria ocrisia (Hewit. 1868), J C M. NAY (AMNH); VC vi (MZFC).
Chlorostrymon simaethis (Drury 1773), J C M. EREF xii (ADW); Islas Tres Marías (Godman & Salvin 1879 1901); JUM i; LBA i; SIN xii (ADW).
Chlorostromon telea (Hewit. 1868), J C M. LSMO ix (ADW).
Cyanophrys amyntor (Cr. 1775), J M. LBA i (ADW).
Cyanophrys fusius (Godm. & Salv. 1887). Las Varas i (JPB).
Cyanophrys herodotus (Fabr. 1793), J C M. EREF x (ADW); LBA i (ADW); Matanchén ix (MZFC); NAY (AMNH); NVO i (ADW); SB ix (MZFC), i; SIN xii (ADW).
Cyanophrys miserabilis (Clench 1946), J C M. LYB ix (MZFC).
Cyanophrys longula (Hewit. 1868), J C M. RLNO i,xii (ADW); VC i (MZFC).
Panthiades bitias (Cr. 1777), J C M. COM (Nicolay 1976); NAY (Nicolay 1976: AME, AMNH).
Panthiades ochus (Godm. & Salv. 1887), C M. RLNO ix (ADW).
Panthiades bathildis (C. Feld. & R. Feld. 1865), J C M. Aticama xii (ADW); Aticama, 1 km N vi; El Limón iii (MZFC); JUM i (ADW); iv (MZFC); LBA i,vi (ADW); LBA, 4 km E vi; LYB viii,ix,xi (MZFC); LSMO; Madero (Nicolay 1976: AME); MEC ix (MZFC); i,xii (ADW); PAL xii (MZFC); SB i,vi (ADW); Sayulita vi (LACM); SIN xii (ADW); VC iii,vi (MZFC); Zapata (Nicolay 1976: AME).
Parrhasius orgia (Hewit. 1867), J M. Jalcocotán vii (CIB).
Parrhasius polibetes (Stoll 1781), J C M. JUM iii; PAL xii (MZFC).
Parrhasius moctezuma Clench 1971, J C M. NAY (Nicolay 1979: AMNH); RLNO i,ix,xii (ADW).
Strymon albata (C. Feld. & R. Feld. 1865), J C M. JUM i,xii (ADW); xii; Mirador del Aguila iii (MZFC); NAY (AMNH); SIN i,xii (ADW).
Strymon alea (Godm. & Salv. 1887), J M. Islas Tres Marías (Godman & Salvin 1879 1901, Clench 1966).
Strymon bebrycia (C. Feld. & R. Feld. 1865), J C M. NVO xii (ADW).
Strymon bazochii (Godart [1824]), J C M. VC vii (MZFC).
Strymon yojoa (Reak. [1867]), J C M. BUC i; LBA i (ADW); LSMO vii (RH); MEC i; NVO i,xii (ADW) PAL xi (MZFC); RLNO i,ix,xii (ADW); VC i,vi (MZFC).
Strymon cestri (Reak. [1867]), J C M. RLNO ix (ADW).
Strymon istapa (Reak. [1867]), J C M. BUC i,xii (ADW); El Palillo iii (MZFC); EREF xii (ADW); Isla María Madre xii (CIB); JUM xi (MZFC); LBA i (ADW); LYB iii (MZFC); MEC i (ADW); vi (MZFC); NVO i,xii; RLNO xii; SIN xii (ADW); TEP, E of xii (LACM).
Strymon ziba (Hewit. 1868), J C M. NAY viii (USNM); Jalcocotán viii (CIB); PAL xii (MZFC).
Strymon megarus (Godart [1824]), J M. JUM i; LBA i; NVO xii (ADW); PAL vii (MZFC); SIN xii (ADW).
Strymon serapio (Godm. & Salv. 1887), J C M. JUM iii (MZFC).
Ziegleria syllis (Schaus 1902), M. LBA i,vi; SIN xii (ADW).
Ziegleria ceromia (Hewit. 1877), as *Kisutam ceromia* by Warren et al. (1998), J C M. LBA i (ADW); Las Varas, 8 mi S i (JPB).
Ziegleria guzanta (Schaus 1902), as *"Thecla" guzanta* by Vargas et al. (1996), J M. RLNO i (ADW).
Ziegleria hesperitis (Butl. & H. Druce 1872), as *"Thecla" hesperitis* by Vargas et al. (1996), J. PAL xii (MZFC).
Electrostrymon joya (Dognin 1895), as *E. canus* (Druce 1907) by Warren et al. (1998), J C M. Isla María Magdalena xi (CIB).
"Thecla" arza (Hewit. 1874). PAL i,xii (MZFC).
Symbiopsis sp., as *Symbiopsis* aff. *tanais* (Godm. & Sal. 1887) by Warren et al. (1998), C M. Pintadeño vi,x; SIN ix, (MZFC). Apparently an undescribed species.
Calycopis demonassa (Hewit. 1868), J C M. LBA i (ADW); LBA, 4 km E vi (MZFC); NAY (AMNH).
Calycopis clarina (Hewit. 1874), J C M. LBA i; RLNO ix (ADW).
Calycopis isobeon (Butl. & H. Druce 1872), J C M. COM x (Field 1967); EGUM xii (ADW); JUM i (ADW), xi; LBA iv,ix (MZFC), i,vi (ADW); LBA, 4 km E vi (MZFC); LYB x (MZFC); MEC x (ADW); NAY (AMNH); NVO xii (ADW); PAL iii,vii,x,xi (MZFC); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN xii (ADW); vi,ix (MZFC); VC ix,xi (MZFC).
Tmolus echion (L. 1767), J C M. JUM xi; LBA ix (MZFC), i; MEC xii; NVO xii (ADW); PAL vii,xii (MZFC); Sierra Madre de Tepic (Godman & Salvin 1879 1901); VC xii (MZFC).
Tmolus crolinus (Butl. & H. Druce 1872), C. LSMO, 2.8 mi S on Hwy 15 viii (MZFC).
Nicolaea velina (Hewit. 1868), as *"Thecla" phobe* (Godm. & Sal. 1887) by Vargas et al. (1996), J M. MEC x (ADW); Paso de Mesillas (km 54, Hwy 200), 2 mi NE i (JPB).
Ostrinotes keila (Hewit. 1869), as *"Thecla" keila* by Warren et al. (1998), J C M. EREF ix (ADW); JUM x; LBA ix (MZFC).
"Thecla" gargophia (Hewit. 1877), M. TEP, 5 12 mi N i (JPB).
"Thecla" thoria (Hewit. 1869), M. SIN xii (ADW).
Theclopsis mycon (Godm. & Salv. 1887), J C M. EREF xii (ADW); JUM viii; LBA vi,ix (MZFC), i,vi (ADW); LBA, 4 km E vi; LYB vi,xi; PAL iii,vii,xi (MZFC); SIN xii (ADW); VC iv (MZFC).
Strephonota tephraeus (Geyer 1837), as *Siderus tephraeus* by Warren et al. (1998), J C M. JUM iv,xi; LBA x (MZFC); SIN xii (ADW).
Ministrymon clytie (W.H. Edwards 1877), J C M. JUM vii,viii (MZFC), ix,xii; LSMO ix (ADW); MEC vi (MZFC); NVO xii; SB i,vi; SIN xii (ADW).
Ministrymon phrutus (Geyer 1832), J C M. LSMO ix (ADW).
Ministrymon azia (Hewit. 1873), J C M. BUC xii; JUM i (ADW), vii (MZFC); LBA i; RLNO i; SIN xii (ADW).
Ministrymon arola (Hewit. 1868), M. JUM xii (MZFC).
Ministrymon una (Hewit. 1873), M. Aticama, 1 km N vi; Aticama, 2 km N vi; JUM xi, (MZFC); SB vi (ADW); VC vi (MZFC).
Nesiostrymon calchinia (Hewit. 1868). Aticama, 1 km N vi (MZFC); LBA vi (ADW); VC vi (MZFC).
Ipidecla miadora Dyar 1916, J C M. LSMO ix (ADW).
Brangas neora (Hewit. 1867), J C M. LSMO viii (AME).
Erora subflorens (Schaus 1913), M. LSMO ix (ADW, MZFC).
Erora nitetis (Godm. & Salv. 1887), J M. RLNO xii (ADW).
Erora opisena (H.H. Druce 1912), M. LBA ix (MZFC); RLNO i (ADW).
Dicya carnica (Hewit. 1873), as *Caerofethra carnica* by Warren et a. (1998), C M. BUC i (ADW).
Brephidium exilis exilis (Boisd. 1852), C J M. SB vii (ADW); SIN ix (MZFC).
Leptotes marina (Reak. 1868), C J M. COM v (CUIC); JUM xi (MZFC), i (ADW); LYB iv (MZFC); NAY (AMNH); PAL iii (MZFC); RLNO ix,xii (ADW); Sierra Madre de Tepic (Godm. & Salv. 1879 1901).
Leptotes cassius cassidula (Boisd. 1870), as *L. c. striata* (W. H. Edw. 1877) by Warren et al. (1998), J C M. BUC i,xii; EGUM i,xii (ADW); El Palillo iii (MZFC); EREF x,xii (ADW); Hwy 200, 4 rd km S San Ignacio ii (LACM); Isla María Madre xii (CIB); Islas Tres Marías (Godman & Salvin 1879 1901); Jalcocotán ix; JUM

iii,iv,vii,ix,x (MZFC), i,ix,xii; LBA i (ADW); LYB iv,vi,ix,x; LSMO ix (MZFC), ix (ADW); MEC vi,x (MZFC), i,vi,x,xii (ADW); NAY (AMNH); NVO i,xii (ADW); PAL i,iii,x xii; Pintadeño x (MZFC); RLNO i,ix,xii (ADW), ix (MZFC); SB (Godman & Salvin 1879 1901), i (ADW); SIN iv (MZFC), xii (ADW); Tepetilte; VC iii,xii (MZFC).

Zizula cyna (W.H. Edw. 1881), J C M. EGUM i (ADW); El Palillo iii (MZFC); JUM i (ADW); LBA iii (MZFC), i,vi (ADW); LYB x (MZFC); MEC i (ADW); Mirador del Aguila iii (MZFC); NAY (AMNH); PAL i (MZFC); RLNO i (ADW); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN iii (MZFC), xii (ADW); VC vi (MZFC).

Hemiargus ceraunus zachaeina (Butl. & Druce 1872), J C M. Aticama xii; BUC i,iii,xii; EGUM i,xii; EREF xii (ADW); Isla María Madre xii (CIB); JUM iii,iv,vii ix (MZFC), i,ix,xii; LBA i (ADW); LYB vi; LSMO ix (MZFC), ix (ADW); Matanchén; MEC vi (MZFC), i (ADW); NAY (AMNH); NVO i,iii,xii (ADW); PAL iii; Pintadeño iv (MZFC); RLNO i (ADW); SB (Godman & Salvin 1879 1901, as *hanno* Stoll [1792]), i,vi (ADW), xii (CAS); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN ix (MZFC), xii (ADW); VC iv (MZFC).

Echinargus isola (Reak. [1867]), as *Hemiargus i. isola* by Warren et al. (1998), J C M. EREF xii (ADW); JUM iv (MZFC); NAY (Hoffmann 1940); PAL iii (MZFC); RLNO i,ix,xii (ADW), ix (MZFC); SB (Godman & Salvin 1879 1901) VC vi,xi (MZFC).

Cupido comyntas (Godart [1824]), as *Everes comyntas* in Warren et al. (1998), J C M. BUC xii (ADW); El Palillo iii (MZFC); EREF xii (ADW); JUM xii (MZFC), i,xii; LBA i,vi (ADW); LYB iii,vi (MZFC); NVO i,xii (ADW); PAL iii (MZFC); RLNO i,ix (ADW), ix,xi (MZFC); SB (Godman & Salvin 1879 1901), vi (ADW); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN vi (ADW); Tepetilte; VC vi (MZFC).

Celastrina gozora (Boisd. 1870), J C M. LYB x (MZFC); PAL xii (MZFC); RLNO i,ix,xii (ADW), ix (MZFC); Sierra Madre de Tepic (Godman & Salvin 1879 1901); SIN ix; VC i,iii,iv,xi,xii (MZFC). The relationship of *gozora* to other North American *Celastrina* taxa, especially *cinerea* (W. H. Edw. 1863), remains to be elucidated.

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NOTES ON THE STATUS, NATURAL HISTORY AND FIRE-RELATED ECOLOGY OF *STRYMON ACIS BARTRAMI* (LYCAENIDAE)

Additional key words: Croton, Florida, West Indies, prescribed fire.

The Bartram's hairstreak, *Strymon acis bartrami* (Comstock & Huntington) (Lycaenidae) (Fig. 1) is endemic to southern Florida and the lower Florida Keys (Baggett 1982, Schwartz 1987, Minno & Emmel 1993, Smith et al. 1994). Although still occurring locally in parts of Monroe and Miami-Dade Counties, populations of this subspecies have been extirpated from the majority of its historic range, which may have extended northward to Palm Beach County on eastern peninsular Florida (Baggett 1982, Minno & Emmel 1993, Minno & Emmel 1995Smith et al. 1994) (Fig. 2). A number of studies have been undertaken to survey the remaining populations of *S. a. bartrami* and to attempt to identify factors contributing to their decline in recent decades (Schwartz 1987, Hennessey & Habeck 1991, Hennessey et al. 1992, Schwarz et al.1996, Emmel et al. 1996, Salvato 1999, 2001, in press). The purpose of this paper is to provide an updated discussion on the role of fire on the population ecology of *S. a. bartrami* within the pine rocklands of south Florida and the keys. We also present natural history observations of *S. a. bartrami* natural history elicited during our field studies.

***Strymon a. bartrami* and fires**. Pineland croton, *Croton linearis* Jacq. (Euphorbiaceae), the sole host plant of *S. a. bartrami*, is restricted to pine rockland habitat (Schwarz et al. 1996, Salvato 1999). Modern development has removed and/or fragmented the pine rocklands from the majority of their former range on peninsular Florida and the lower Florida Keys (Anonymous 1999, Salvato 1999). Historically, pine rockland habitat covered 65,450 ha within Miami-Dade County (Loope & Dunevitz 1981, Anonymous 1999). At present, outside of Everglades National Park (ENP), there are 375 pine rockland fragments of approximately 1,780 ha remaining in Miami-Dade County (Anonymous 1995). Big Pine Key, part of the National Key Deer Refuge, retains the largest undisturbed tracts of pine rockland habitat in the lower Florida Keys totaling approximately 701 ha (Folk 1991, Hennessey & Habeck 1991, Salvato 1999). Although relict pine rocklands can still be found on several other islands within the refuge, only Big Pine maintains *C. linearis* (Salvato 1999). As a result, *S. a. bartrami* is present only on Big Pine within the Florida Keys. Here, populations of this subspecies range from locally common to prolific, limited by abundance of new host plant growth (Hennessey & Habeck 1991, Salvato 1999) and possibly the frequency of mosquito control pesticide applications to the pine rockland habitat (Hennessey et al. 1992, Salvato 1999, 2001). On the mainland, the butterfly maintains population levels that are sporadic and rarely encountered (Lenczewski 1980, Salvato 1999) in the Long Pine Key (LPK) portion of ENP, which contains the largest remaining coverage of pine rockland habitat (8,029 ha) on peninsular Florida (Anonymous 1999). Only a few of these fragments, ones that are adjacent to ENP, such as Navy Wells Pineland Preserve and Camp Owaissa Bauer Hammock, appear to maintain small, localized populations of *S. a. bartrami*.

FIG. 1. *Strymon acis bartrami* on Long Pine Key, Florida, November 22, 2003 (Photo Credit: H. L. Salvato).

Natural fires in the pine rocklands are a major force in regulating and maintaining the herbaceous layer of the pine rockland of which *C. linearis* is a part (Loope

FIG. 2. Distribution of *S. a. bartrami* in Florida. Only Monroe and Miami-Dade Counties (black triangles) are confirmed as locations for the species. The occurrence of *S. a. bartrami* in Palm Beach County (open triangle) is unconfirmed. Adapted from Minno & Emmel (1995).

& Dunevitz 1981, Carlson et al. 1993, Olson & Platt 1995, Bergh & Wisby 1996, Platt et al. 2000). However, due to the proximity of remaining pine rockland habitat to urban areas in southern Florida and the keys much of these natural fires have been suppressed, often replaced by inconsistent regimes of managed or prescribed fires.

Prescribed fire has been consistently used for the past 50 years throughout the pine rocklands of LPK (Loope & Dunevitz 1981, Salvato 1999). From 1989 to date, LPK fire management has ignited prescribed fires every 2-3 years to mimic natural fire regimes historically instigated by lighting strikes (Robertson 1953, Slocum et al. 2003). Although this policy has resulted in restoration of species-rich herbaceous-dominated pine rocklands in many areas, including resurgence of *C. linearis*, the populations of this plant remain fragmented. Fragmentation may prevent *S. a. bartrami* from achieving the widespread distribution it maintains across the majority of Big Pine Key, where host-plants grow unrestricted in many areas (Lenczewski 1980, Hennessey & Habeck, 1991, Salvato 1999, Salvato in press).

During the few instances when the butterfly has been observed at LPK in recent decades (Hennessey & Habeck 1991, Emmel et al. 1996, Salvato 1999, Salvato in press), it has preceded new prescribed burns to the very areas where the localized populations of *S. a. bartrami* had been reported. MHS (unpublished) observed and monitored adult and larval *S. a. bartrami* activity in 2002-03 at gate 4 in LPK. The northern portion of gate 4 was burned on 10 May 2003. However, the majority of the southern portion was left unburned. Such burning of select portions of the pine rockland habitat has likely prevented extirpation of *S. a. bartrami* in LPK because partial and systematic prescribed burns may allow *S. a. bartrami* adults a corridor (refugium) for re-colonization. Numerous areas in LPK with smaller *C. linearis* densities have likely been lost to *S. a. bartrami* because these were entirely burned and lack adjacent host-bearing pine rockland refugia.

Another factor possibly complicating *S. a. bartrami* re-establishment between burn intervals is the length of time required for the host to regenerate sufficiently to be a suitable host. Lenczewski (1980), Hennessey & Habeck (1991) and Salvato (1999) have indicated that although *C. linearis* re-sprouts within one to three months after a fire, it appears in some areas inaccessible and in all instances undesirable to *S. a. bartrami* as a host source. We found that although *S. a. bartrami* is present in the pine rocklands following burns, they do not appear to oviposit on the new growth of *C. linearis*. A significant difference in the adult density of *S. a. bartrami* occurred in 1989 following a prescribed burn in October 1988 in Watson's Hammock on Big Pine Key, when compared to other study areas in Watson's Hammock and Big Pine Key that had not been burned at that time (Hennessey & Habeck 1991). MHS (unpublished) actively surveyed an 8 ha parcel of pine rockland on central Big Pine Key for *S. a. bartrami* prior to and following a prescribed burn administered in August 2001. MHS (unpublished) noted that, although ample amounts of host plant were available at about three months post-burn (during late November 2001) for oviposition, this new plant growth was not visited by *S. a. bartrami*. *S. a. bartrami* targets new growth for oviposition on otherwise established host plants (Hennessey & Habeck 1991, Salvato 1999). Prior to the August 2001 prescribed fire this survey location maintained an estimated *S. a. bartrami* population of 10 adults/ha (MHS unpublished). Following the August 2001 prescribed fire there were few observations of adult butterflies and no visible larval activity at the burned location until the following spring (late March 2002) when larvae were located on the resurgent host plants and adults were recorded at pre-burn abundance, a level they would retain until the next burn. MHS (unpublished) monitored a second prescribed burn at this same central Big Pine location that

occurred in August 2003 and noted that, while still present at other survey locations, *S. a. bartrami* was absent at this burned site immediately following the fire. Lenczewski (1980) suggested that, although fairly common in nearby unburned locations, *S. a. bartrami* would not return to burned pine rocklands in Miami-Dade County for up to five months following a burn. From our observations of reduced adult and absent larval activity at burned locations (Hennessey & Habeck 1991, MHS 2001-03 unpublished), we suspect *S. a. bartrami* does not use *C. linearis* for oviposition for approximately eight months post-burn.

Watson's Hammock on northwestern Big Pine Key, where *S. a. bartrami* has historically been abundant, has experienced several decades of natural fire suppression combined with inadequate prescribed fire management. This has resulted in scattered populations of *C. linearis* and much lower densities of *S. a. bartrami*. Hennessey & Habeck (1991) recorded low densities of *S. a. bartrami* adults at Watson's Hammock as well as within LPK during their 1988-89 surveys. Although Salvato (1999, 2001) encountered large densities of *S. a. bartrami* adults at several areas of Big Pine Key during his 1997-98 surveys, a decline in numbers from previous studies was noted at Watson's Hammock and LPK. Continuing field surveys by MHS (unpublished) during 2002-03 have indicated that *S. a. bartrami* remains scarce within LPK (2 adults and a single 1st instar larva found over 30 sampling dates) and either extirpated or extremely localized throughout many areas in Watson's Hammock (12 adults found over 30 sampling dates).

The influence of burn intervals on threatened subspecies, such as *S. a. bartrami*, requires immediate investigation by researchers and land managers. More selective prescribed burns, coupled with augmentative adult *S. a. bartrami* releases could perhaps be used to increase population numbers in LPK and, if ultimately necessary, within Watson's Hammock.

Although restricted in the Everglades, chemical pesticide applications for mosquito control have been shown to play a significantly negative role in the natural history of butterflies in the Florida Keys (Emmel & Tucker 1991, Eliazar 1992, Hennessey et al. 1992), including those on Big Pine (Salvato 2001). The only pine rockland location on Big Pine where, historically, chemical pesticide treatments have been restricted is Watson's Hammock. Therefore any possible advantage the species might receive from the absence of chemical pesticides in Watson's Hammock is now difficult to ascertain due to a lack of consistent prescribed fire management needed to maintain adequate densities and distribution of hostplant.

Natural history observations. The natural history of *S. a. bartrami* was discussed initially by Comstock & Huntington (1943) and later by Opler & Krizek (1984). Smith et al. (1994) describe the taxonomy and ecology of various Antillean subspecies of *Strymon acis* Drury. Although briefly discussed by Chermock & Chermock (1947), it was Worth et al. (1996) who provided the most detailed natural history account to date of *S. a. bartrami* including a description of its early stages. Numerous notes were made on the natural history of this subspecies during field studies conducted by Hennessey & Habeck (1991) in 1988-89 and Salvato 1997-2003; some of these observations are reported in the remainder of this paper.

S. a. bartrami was observed on several occasions ovipositing on the terminals of *C. linearis*. Hennessey & Habeck (1991) observed a female oviposit three eggs over the course of five minutes. *C. linearis* is a dioecious plant. Most field observations of egg oviposition made by the authors Hennessey & Habeck (1991) (2 out of 2 in 1988-89) and MHS (unpublished) (39 out of 42 in 2002-03) were on male plants. Oviposition was observed only on flowering terminals. Beyond the first two instars, more mature larvae were located feeding throughout the host plant showing no apparent preference for plant gender. Hennessey & Habeck (1991) found six larvae (2 on female plants, 4 on male in 1988-89) and MHS (unpublished) has found larval stages (beyond the 2nd instar) feeding equally on both genders of host (25 female, 29 male during 1997-2003). We have recorded body lengths of 2, 4, 6 and 11mm for *S. a. bartrami* 2nd through 5th instar, respectively (based on 10 measurements of each instar in the field at Long Pine Key and Big Pine Key). Hennessey & Habeck (1991) estimated the duration time for developmental stages 4th instar through pupa to be 6, 7-9 and 13-14 days, respectively (however, this was based on only two field collected specimens from Big Pine Key). There have been no observed instances of obligatory relations of *S. a. bartrami* larvae and ants during this or other studies of the subspecies (Worth et al. 1996). Hennessey & Habeck (1991) collected a fifth-instar larva of *S. a. bartrami* on Big Pine from which a single braconid wasp was produced during pupation on 18 June 1989 . To our knowledge this is the only known record for a parasitoid from this subspecies. Due to the fact the subspecies pupates in the ground litter (Worth et al. 1996), tracking the fate of *S. a. bartrami* pupae is extremely difficult. Collection of other late instar *S. a. bartrami* larvae is needed to determine the influence of parasitism on its early stages.

We have recorded *S. a. bartrami* activity during every month on Big Pine Key; however the exact num-

ber of broods appears to be sporadic from year to year. Baggett (1982) indicated that *S. a. bartrami* seemed most abundant in October-December. Salvato (1999) recorded 92 adult *S. a. bartrami* from Big Pine Key during a one-week period in July 1997, suggesting the subspecies can occur prolifically. Adult *S. a. bartrami* were always found within the pine rockland habitat and in close proximity with their host (Schwartz 1987, Worth et al.1996, Salvato 1999). However, Minno & Emmel (1993) report a few records for *S. a. bartrami* from Key Largo, a location without historic records for the host plant. Although these individuals were likely strays from the mainland, the species is known to disperse when host plants are in flower. During the winter months on Mona Island (located between the Dominican Republic and Puerto Rico) large numbers of *Strymon acis mars* Fabricius have been recorded attracted to flowers of other plants when *Croton* flowers were scarce (Smith et al. 1994). *S. a. bartrami* was most often observed visiting flowers of the host during our studies in south Florida. Although it was observed visiting the flowers of several of the non-host species mentioned by other studies (Minno & Emmel 1993, Worth et al. 1996, Calhoun et al. 2000) for nectar, MHS (unpublished) frequently observed the butterfly visiting pine acacia, *Acacia pinetorum* (Small) Hermann (Fabaceae) on Big Pine Key.

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FEEDING ADULT BUTTERFLIES IN SMALL CAGES

Additional Key Words. butterfly feeder, lab-rearing, small cages

Most free-ranging butterflies feed frequently throughout their daily flight period and deteriorate if deprived of nutrients (Boggs 1997a, b, Boggs & Ross 1993). Although most caged Lepidoptera feed freely from open containers of sugar-water, they must be kept out of the solution or their wings stick together, stick to the cage, or stick to a cage mate. There is no way to clean the wings of soiled individuals and they deteriorate rapidly. Hand-held, pipette feeding is not a good long-term solution because it is time consuming and handling damages the wings, reduces longevity, and can alter behavioral and physiological phenomena being studied.

Most apparatus for feeding caged butterflies have large, exposed sticky surfaces, e.g., 1) saturated pads of polyurethane foam in 100cm petri dishes, 2) saturated cotton in 100ml beakers and 3) petri dishes of sugar water covered with bridal veil fabric (Hughes et al. 1993). Sticky surfaces are better tolerated in large cages, but cause big problems in small cages. Small cages keep the butterflies closer to the feeding station and their movements appear more erratic, less purposeful and result in frequent contact with objects in the cage. Unfortunately, large cages are not compatible with the parameters of some investigations, e.g., keeping experimental groups separated in temperature and light-control chambers, maintaining individual identification, and transporting alpine species to the lab in coolers.

Hughes et al. (1993) describe a feeder made from a conical centrifuge tube with a screw cap. The feeder I use (Fig. 1a) is similar, but is made from a syringe. Syringes are easier to fill, inexpensive, and available in more sizes. Also, the syringe barrel has flanges to hold it in place when dropped through a hole in the top of a cage. The port designed to accept a needle is plugged by forcing a round wooden toothpick into the hole and breaking or cutting it off. A single feeding port is drilled in the side of syringe, at the needle end (see Fig. 1a). A hole should not be drilled through both sides of the syringe because if one hole is drilled

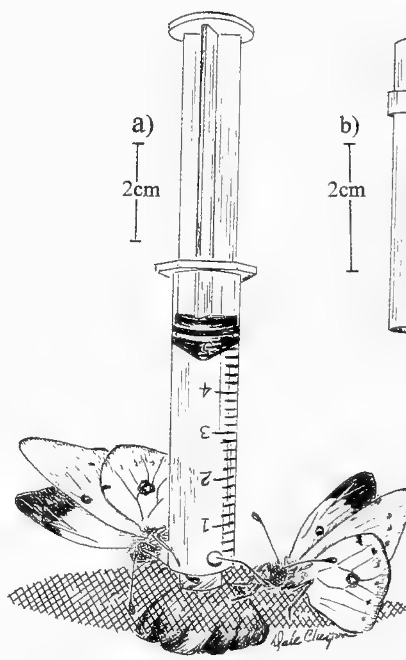

FIG. 1. a) *Colias eurytheme* at a 5 ml syringe feeder. A circle of fiberglass window screen between the syringe and modeling clay base keeps butterflies out of any sticky solution that might leak on to the cage bottom. b) A 6 X 50 mm disposable culture tube feeder with a ring cut from rubber or tygon tubing to keep it from slipping through a hole in top of the cage.

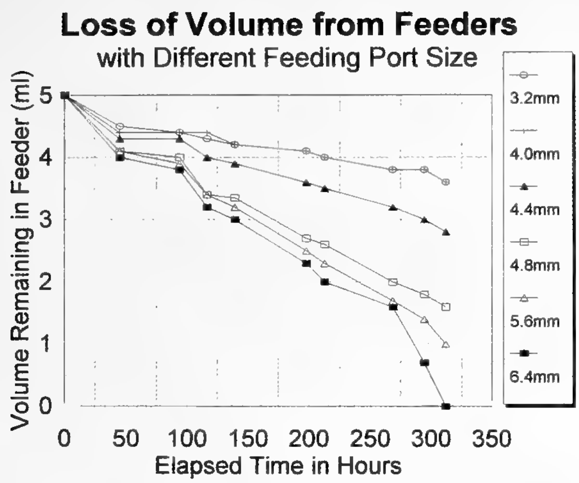

FIG. 2. Water-loss from six 10 ml syringe feeders with feeding port size ranging from 0.32 to 0.64 cm (1/8 to 1/4 inches). Each feeder held 5 ml of water and 5 ml of air at the beginning of the recording.

slightly above the other, or the syringe is tilted, air bubbles can enter the more elevated hole and fluid drains from the lower hole to the bottom of the cage. Butterflies have no problem finding a single small hole. Yellow or red food coloring in the fluid, and/or colored tape near the feeding-port can serve as orientation cues. Common food flavorings (eg., anis, mint, vanilla) can be added as attractants.

This feeder can be suspended through a hole in the top of the cage or held upright by inserting the needle port into a piece of modeling clay or into a hole drilled in a small block of wood. A circular piece of fiberglass screen held just above the cage floor by the modeling clay base (see Fig. 1a) will keep the subjects out of sticky fluids that may drip from the feeder.

To determine the best hole size, I made six 10 ml feeders with holes graded from 3.2 to 6.4 mm (1/8 to 1/4 inch) in diameter. The butterflies I tested (e.g. *Asterocampa celtis*, *Oeneis chryxus*, *Erebia epipsodea*, *Danaus plexippus*) found the small holes as readily as the large holes. I filled the syringes to the 5 ml mark with water and the remaining 5 ml, with air to test the effect of changes in air volume with temperature and barometric pressure. No dripping was detected, but all feeders lost water due to evaporation, and the one with the largest hole (6.4 mm) went dry on day 13. A plot of volume change (Fig. 2) shows that the feeders lost water proportionally to the cross-sectional area of the holes drilled into them. Water loss was approximately 0.0005 ml/mm^2/hr for all hole sizes. Fig. 2 suggests that environmental changes (eg., humidity, air currents) caused similar shifts in the rate of water loss from all pore sizes, over time. These shifts are more evident for larger diameter ports. If feeding rates are being tested, a control feeder can be used to correct data for such incidental fluid loss.

The volume scale on the syringe is convenient for quantifying ad-lib feeding rates or preferences between different nutrients, colors, flavors, etc. Plastic syringes can be obtained in a variety of sizes from a pharmacy or veterinary supply. Small diameter syringes (0.5 and 1.0 ml) give more precise measurement of small volume consumption.

A second type of feeder I use in small cages is a 6 X 50 mm disposable culture tube (Fig. 1b). These tubes are inexpensive and common in microbiology labs, or they can be made by heat sealing one end of glass tubing. These feeders are best filled using a syringe and needle to deliver fluid to the bottom of the tube. After filling, the tube can be inverted and slipped through a hole in the top of the cage. A 3-5 mm long ring of tygon or rubber tubing, fitted near the closed end of the tube (see Fig. 1b), keeps it from slipping through the hole. The tube diameter is small enough that fluid will not drip, but air bubbles form and rise to keep fluid at the lower end.

Reference to "sugar-water" was used to simplify discussion and not to imply that it is an adequate diet for adult Lepidoptera. Hill (1989) and Boggs (1997a, b) demonstrated that amino acids and other nutrients obtained by both adults and larva affect fecundity and longevity in some species. Among free-ranging Lepidoptera, some species depend entirely on nutrients obtained as larva and never feed as adults, e.g., female Megathyminae (Scott 1986). Others require energy from carbohydrates found in nectar (Romeis & Wackers 2000, 2002). Lepidoptera with longer, more complex adult lives have more complex nutritional needs, including electrolytes, amino acids, lipids, and carbohydrates, to repair anatomical structures, maintain physiological homeostasis, produce gametes, migrate, defend territories and other adult activities (Karlsson 1998, Schappert 2001). Butterflies feed from a variety of sources including nectar, pollen, tree sap-flows, over-ripe fruit, mud puddles (imbibing water to concentrate salts and minerals), bird and mammal excrement, blood, sweat, tears, and other body fluids (Dowes 1973, Banziger 1971, Arms et al. 1974, Scott 1986, Boggs & Jackson 1991, Erhardt & Baker 1990, Estrada & Jiggins 2002, DeVries et al.1997, Mevi-Schutz & Erhardt 2002, Penz 2000, Romeis & Wackers 2002 . Rusterholz & Erhardt 2000, Krenn et al. 2001, Schappert 2001).

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BOOK REVIEW

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MOMPHIDAE, BATRACHEDRIDAE, STATHMOPODIDAE, AGONOXENIDAE, COSMOPTERIGIDAE, CHRYSOPELEIIDAE, by J. C. Koster & S. Yu Sinev. *In* MICROLEPIDOPTERA OF EUROPE 5, P. Huemer, O. Karsholt and L. Lyneborg (eds). Apollo Books, Stenstrup. 2003. 387 pp. ISBN 87 88757 66 8.

This volume of the reputable *Microlepidoptera of Europe* series introduces 158 species classified to belong to the gelechioid families Momphidae, Batrachedridae, Stathmopodidae, Agonoxenidae, Cosmopterigidae and Chrysopeleiidae. In addition, it illustrates a few species whose systematic position is unclear. The book covers not only Europe but also North Africa and the Near East. It provides all that one needs to identify their specimens; the illustrations are absolutely fantastic and enable identification of most species readily. The species characterisations are informative, and represent up-to-date knowledge of the species. The volume also provide a thorough introduction to the convoluted history of the systematics of the families. However, the distribution table - probably the most annoying part of preparing a book like this - might leave something to to be desired; I checked just the column of Finland and found one absence and two unfounded presences of species although an updated Finnish checklist would have been available and easy to check. I have no idea how accurate the table is otherwise. The biology of the species is outlined in much detail with a critical treatment of doubtful old literature records. So I am very happy to claim that the book serves its purpose, being an excellent identification tool and source of revised biological information. It also gives aesthetic pleasure by giving justice to the striking beauty of many of these little beasts.

The coin has two sides. The book deals with several putatively non-related gelechioid families. As the independence of the families is emphasized to the extreme by the authors (see below) I find the title of the book, 'Momphidae s. l.,' on its cover very confusing. Should not this kind of a landmark book attempt to get rid of old misconcepts, instead of repeating them? Likewise, why is the collective term "the narrow-winged moths" still used for this assemblage of taxa characterised by generally (but not invariably) narrow wings, but not for some others (e.g. Coleophora) that are at least as narrow-winged? It would be best to get rid of such collective unfounded terms instead of promoting their use to characterise a claimed unnatural grouping. I think it inconsiderate to use them in this kind of standard book which is likely to become a classic.

This leads us to the issue of systematics and classification followed in this volume. The authors state the following about ranking of the families: "Each of the six families of narrow-winged moths possesses a number of good autapomorphies…, and this is a reason to keep their high taxonomic rank". This said, the authors obviously chose to follow the nowadays less fashionable 'evolutionary' classification. Without going into the 'phylogenetic versus evolutionary classification' discussion, one would hope that in the selected philosophy of classification its internal logic be honored. In phylogenetic systematics the position of origin is what predominantly dictates the status of a group, in evolutionary classification the amount of divergence (anagenesis) is the issue. To fulfil the requirements of the evolutionary classification the groups should be very distinctive to warrant their family status. The reader hopes to see good argumentation to support the families, especially as the classification is quite different from that proposed by Hodges (1998). But, this book does not quite succeed in this. The reader, especially one with some general knowledge on the Gelechioidea, is left to wonder what the 'good apomorphies' possibly are. Here are some details.

For Batrachedridae two apomorphies are listed: wings extremely narrow with reduced venation, and resting position very peculiar - neither of these are expanded upon to give the reader an impression of the details of these vague statements. The family status of Batrachedridae is further supported by the following arguments: "unspecialized larval life style, trophic relations with generative organs of mostly trees, as well as scanty of species and absence of evident geographc centres of diversity speak in favour of the viewpoint that the family represents a small advanced group of gelechioid moths with some very peculiar characters. Thus, we treat Batrachedridae as a monophyletic and well separated family, closely related to the Coleophoridae". These conclusions simply do not follow from these arguments. This is next to nonsense unless the conclusions are based on some other data not mentioned. If they are based on the phylogenetic analyses of Sinev (1992, 2002) as stated in the Introduction, it does not help much as these references only contain similar non-analytical

considerations without showing the original data, instead of analyses of phylogeny. For the family Momphidae no characteristics are pointed out to be apomorphic. For the Stathmopodidae the characteristcs are: extremely narrow and long wings with very long fringes, ciliate antennae in males, peculiarly armed hindlegs as well as genital duct morphology in female. For Agonoxidae the authors list as apomorphies the considerably enlarged anellus lobes, the more or less weakened valvae and the peculiar leg-shaped appendages of the pupa. The pupal character is at the same time also considered a synapomorphy for families like Ethmiidae, Hypertrophidae etc. The Cosmopterigidae is characterised by some male genital and unspecified wing venation characteristics, stated to be variably developed in different subfamilies, though how remains unmentioned. For the Chrysopeleiidae the reduction of the tegumen, a fusion between the valvae bases and aedeagus and (unspecified) modification of the segment VIII are listed, and the existence of further autapomorphies is implied though not detailed.

These apomorphy lists are in contrast with the statement of all these families possessing a number of good apomorphies. In particular, if the Gelechioidea is regarded as a whole, one will find that many of these or similar characteristics are repeatedly found here and there. Their significance can only be reflected against the entity, and this perspective is lacking in this volume. The authors also seem to “know” the polarities of characters - which are archaic, which are derived. Sometimes these statements are in conflict with common sense. An example is the stathmopodid characterisation of their larvae having 'rather archaic' life style of feeding on reproductive organs of plants or being scavengers or predators of scale insects. I wonder what makes these life history traits archaic - scavenging or especially a predatory mode of life is rare and seemingly quite derived among the generally phytophagous Lepidoptera. Further, as it is growingly obvious that reversing trends in characters must have repeatedly happened in the evolution of the Lepidoptera, the meaning of 'archaic' and 'derived' becomes dubious.

The generic classification is even more obscure, and it would have been good if the authors would have stated that the current use of generic concepts is followed whether it was justified or not. All in all, the systematic considerations are confusing and look like being conjectural rather than derived from hard analytical background, although it is claimed otherwise.

To conclude, this is an excellent and highly recommended book for identification of the species, but I would instruct the reader to turn a blind eye on the systematic treatment of the taxa.

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